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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 15 MAY, 1932 NUMBER 5

MALFORMATION OF THE AUDITORY APPARATUS IN THE NEW-BORN

ASSOCIATED WITH ECTOPIC THYMUS

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CHICAGO

The case presented illustrates a unilateral deformity of the ear and its connections with the central nervous system.

History.—Ve, a boy, was delivered on May 17, 1930, at the Chicago Lying-In Hospital. The child's cry was weak and delayed, although the air passages were clear. From the history and measurements, the baby was premature approximately 8 (lunar) months. The child did not do well from the beginning and died on May 19, forty hours after birth. The total absence of the external ear on the left side made the case of unusual interest.

The mother of the child was a healthy young married woman 23 years of age. The past history showed only diphtheria. Menstruation began at 13 years of age and had been regular. In 1929, she was confined for her first time at the Lying-In Hospital. The baby was stillborn; it was premature 9 (lunar) months. Autopsy showed prematurity, total fetal atelectasis, petechial hemorrhages of the serous mucous membranes, slight hyperplasia of the lymph glands and of the thymus and edema of the leptomeninges. The second pregnancy, the present one, resulted in the baby being born alive, but he lived only forty hours. The presentation in the first delivery was breech, necessitating episiotomy and extraction, while the second was transverse, requiring version and extraction with forceps to the after-coming head. The mother's Wassermann reaction was negative at each pregnancy. The family history showed nothing of note, and the father gave a negative venereal history.

Examination.—Within three hours after death, the baby's body was perfused with formol-dichromate solution. I made serial microscopic sections of the ears and studied the head and neck grossly. Dr. James O'Leary of Washington University, St. Louis, made a study of the brain, while Dr. Humphries of the University of Chicago carried out the general postmortem examination.

Examination of the left side of the head showed an absence of the auricle and external canal. There was a small auricular tag, 3 mm. in diameter, in the region where the tragus should have been. The right auricle seemed peculiar in that the antitragus and the adjacent anthelix did not blend in with the contour of the helix. The temporal bones were removed and cut down to size. On the left side no external auditory canal or drum membrane was found. The region of the membrana tympani appeared filled in with a smooth bony plate, continuous with the squama temporalis. The internal auditory aperture seemed absent, only a slight notch filled with connective tissue indicating where it should have been (fig. 1). No nerve tissue was seen to enter the petrous bone here. The outline of the superior and posterior semicircular canals could be seen. On the right side the

Submitted for publication, Jan. 30, 1932.

external auditory canal, drum membrane and internal auditory meatus with nerve tissue appeared normal. The semicircular canals were seen as on the left side.

Gross dissection of the baby's head showed apparently normal formation of the eyes, nose, postnasal space, eustachian tubes, mouth, tongue, pharynx and larynx. As far as could be traced the following cranial nerves seemed normal on each side:

Fig. 1.—The posterior surface of the temporal bone on the left side. *SC* represents the superior canal; *PC*, the posterior canal; *FS*, the fossa subarcuata; *IAM*, the slit for the internal auditory meatus.

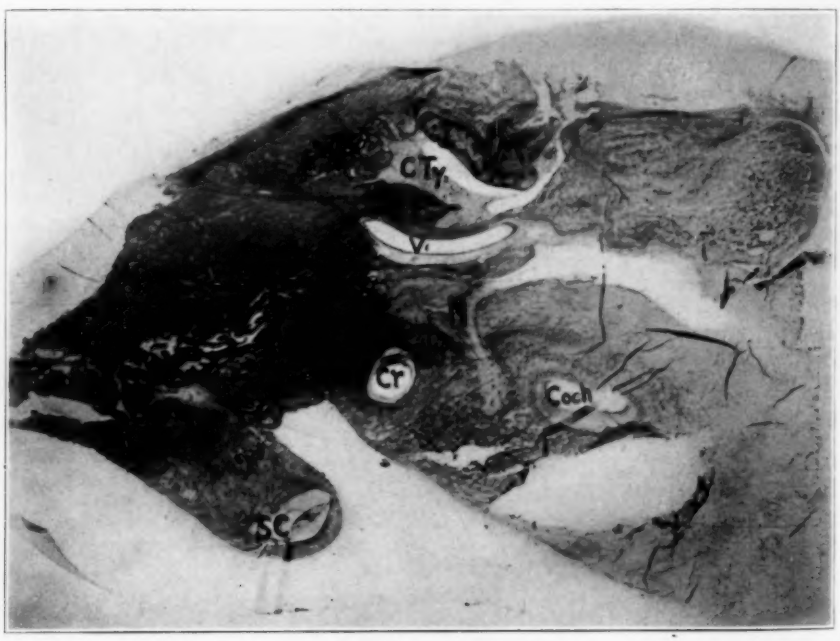

Fig. 2.—Left, horizontal. *I* is the incus; *M*, the malleus; *CTy*, the cavum tympani; V_1, an abnormal vein; *N*, the nerve tissue to the vestibular end-organs; *Cr*, the crista of the superior canal; *Coch*, the cochlea; *SC*, the superior canal; × 6.

the first, second, third, fourth, first two branches of the fifth and the sixth. The seventh nerve could not be made out definitely on either side peripherally. However, this was made difficult because of the previous removal of the temporal bones. It was not possible to identify the ninth to the twelfth nerves, inclusive, also because the temporal bones had been removed. At the time the brain was

removed these nerves seemed to be normally present. On lifting the brain out, I noticed the lack of nerve elements entering the internal auditory meatus on the left side.

Necropsy.—Postmortem examination revealed: a patent interventricular septum (3 mm.); the foramen ovale open, with only a marginal membrane; hemorrhagic bronchopneumonia and peripheral atelectasis; hypoplasia of the ductus arteriosus; undescended testes, and petechial hemorrhages in the visceral pleura and pericardium. Microscopic sections showed early pneumonia of the lung and bilateral hemorrhages in the suprarenals, while sections of the trachea, abdominal aorta,

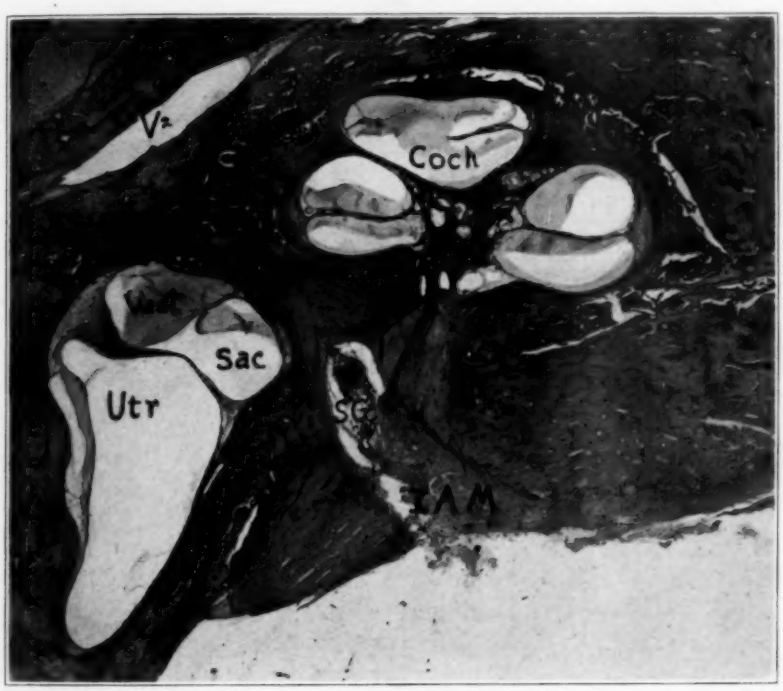

Fig. 3.—Left, horizontal. V_2 is an abnormal vein; *C*, a focus of cartilage in Cozzolino's zone; *Coch*, the cochlea, showing no nerve tissue; *Vest*, the vestibule; *Utr*, the utricle; *Sac*, the saccule; *SG*, Scarpa's ganglion; *IAM*, the internal auditory meatus filled with connective tissue; × 9.

bladder and seminal vesicles, testes and epididymis, kidney, thyroid, thymus, liver and spleen were normal.

Microscopic sections of the left or malformed ear were made from above down. A number of interesting conditions were found. The region of the membrana tympani was filled in mainly by a thin plate of bone, supplemented in part by connective tissue. The malleus and incus were present. The joint region appeared normal (fig. 2), with embryonic connective tissue surrounding the ossicles and filling in most of the cavum tympani. The latter appeared smaller than normal at this level. The anterior and lateral process of the malleus and the long process of

the incus were absent. The short process of the incus was connected by its ligament to the bony wall of the cavum tympani. The manubrium of the malleus was present and connected with the ligament of an apparently normal tensor tympani muscle. The stapedius muscle was absent, as was also the stapes, unless the much thickened tissue simulating a footplate and joint region could be considered as representing the stapedial footplate (fig. 4). A medium-sized vein appeared just medial to the malleus and incus, separated from the ossicles by a thin plate of bone. At first the vein was perpendicular in its course, then bending horizontally it extended posteriorly (fig. 2), where it arrived at the region of the facial canal. Here the vessel again turned downward and became external to the

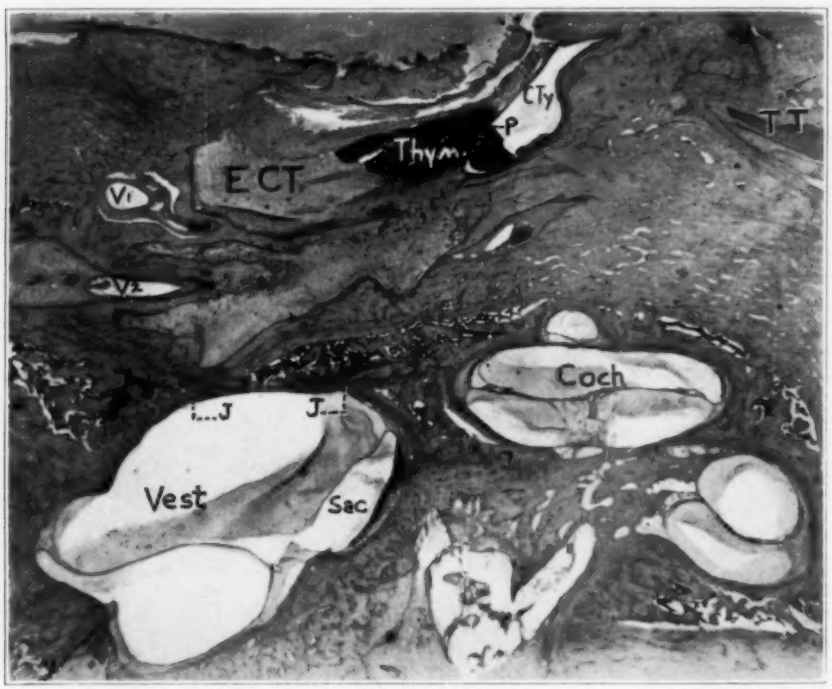

Fig. 4.—Left, horizontal. V_1 and V_2 are abnormal veins; *ECT* is the embryonic connective tissue in the posterior portion of the cavum tympani (*CTy*), the anterior portion containing purulent material (*P*); *Thym* is the mass of thymus tissue; *TT* is the tensor tympani muscle; *JJ* shows the simulated stapedial joints; *Vest* is the vestibule; *Sac*, the saccule; *Coch*, the cochlea, showing the lack of nerve tissue at the base; × 10.

temporal bone at the region of the stylomastoid foramen. A second vein was seen lying in the horizontal plane at the medial wall of the cavum tympani at the level of the crista of the horizontal canal. After disappearing anteriorly it descended posteriorly just medial to the vein previously mentioned and finally also became external to the temporal bone (figs. 3, 4 and 6).

A most unusual and outstanding feature was a mass of thymus tissue found in the cavum tympani. It made its appearance in the embryonic connective tissue

of the cavum tympani at a level just beneath the manubrium of the malleus, and disappeared below at the level of the round window. It separated the cavum tympani into two parts (figs. 4, 5 and 6). The anterior portion of the tympanum was empty except for a moderate amount of purulent material. Anteriorly, this portion was continuous with the eustachian tube, and ciliated epithelium could be seen lining the tubal region (fig. 5). The posterior portion of the cavum tympani was filled with embryonic connective tissue with no evidence of entodermal epithelium. Evidently the thymus tissue interfered with the normal backward extension of the epithelium into the tympanic cavity. Even at the tenth week of fetal life the entodermal epithelium has already extended much farther posteriorly than it has in the present case. In the region of the round window

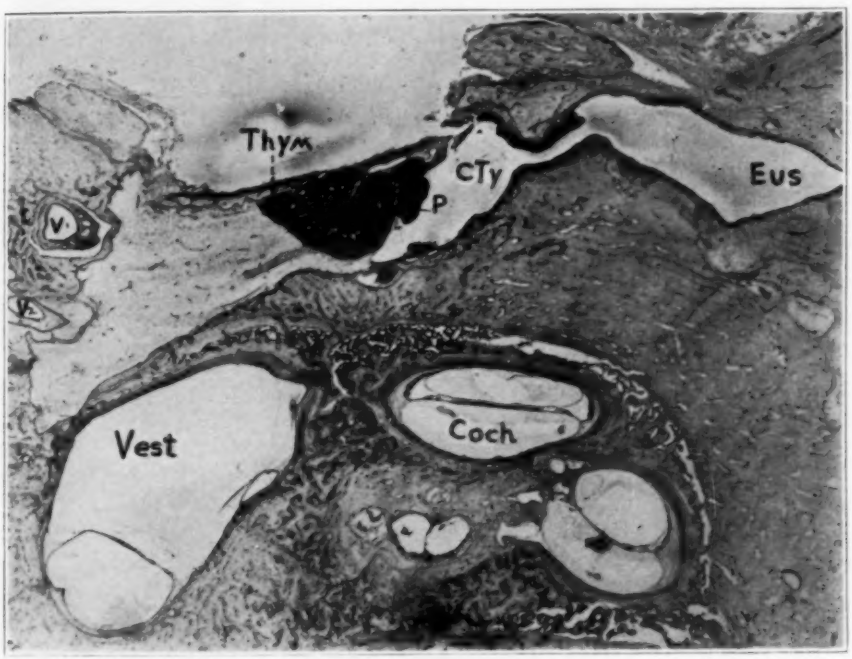

Fig. 5.—Left, horizontal. V_1 and V_2 are abnormal veins; *Thym* is the thymus tissue; *CTy* is the cavum tympani, with anteriorly the region of the (*Eus*) eustachian tube; *P* is purulent material; *Vest* is the vestibule; *Coch* is the cochlea; × 9.

there was a large collection of red blood cells with some phagocytic cells showing ingestion of red corpuscles. The round window itself was normal. The mass of thymus tissue, as examined by Dr. W. Bloom of the Department of Anatomy of the University of Chicago, had a peripheral layer consisting mainly of lymphocytes, with prominent blood vessels, reticular cells and some macrophages. Centrally, there were fewer small lymphocytes and occasional large lymphocytes. Definite pearl formation was seen, suggesting Hassall's bodies. The reticular cells were more prominent here than in the periphery of the nodule. There were some small cystlike structures filled with débris and some polymorphonuclears. Many of the

blood vessels were empty. The mass, with its suggestive division into cortex and medulla and its cellular reticulum and epithelial pearls, together with the closely packed masses of small lymphocytes, resembled thymic tissue very closely, and did not suggest a fetal lymph node. Comparison with microscopic sections of the baby's thymus confirmed this opinion.

In the region of Cozzolino's zone was an area of persisting cartilage (fig. 3). It extended toward the vestibule so as to seem to be continuous with a connective tissue tract running into the vestibule and corresponding to the fissula ante fenestram. However, when studying this region under the low power microscope, it was seen that the tissue possibly represented an abnormal anterior stapedial

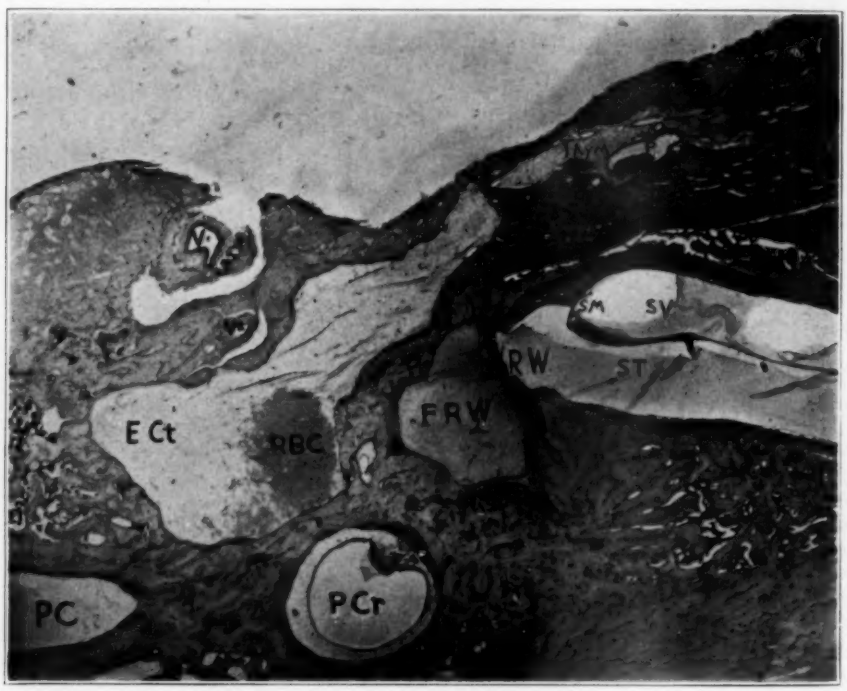

Fig. 6.—Left, horizontal. V_1 and V_2 are abnormal veins; *ECt* is the embryonic connective tissue, with a large collection of red blood cells (*RBC*); *Thym*, the lower tip of the thymus tissue; *P*, the purulent material; *SV*, the scala vestibuli; *SM*, the scala media; *ST*, the scala tympani; *RW*, the round window; *FRW*, the fossa for the round window; *PC*, the posterior canal; *PCr*, the crista of the posterior canal; × 6.

joint and that posteriorly there was another simulated joint region which might have corresponded to the posterior joint (fig. 4). Nevertheless, taking the anterior connective tissue tract by itself, one would say definitely that it was the fissula ante fenestram. The region corresponding to the footplate between the two simulated joint regions consisted of an abnormally wide layer of bone containing many remnants of cartilage.

The end-organs, vestibular and cochlear, were normally developed and quite well preserved (figs. 3, 4 and 6). Scarpa's ganglion was present, and nerve tissue

extended to the vestibular end-organs. However, the number of cells and fibers seemed less than normal. No vestige of a cochlear nerve or spiral ganglion could be found. The cochlea presented only two coils. The modiolus did not appear defective except that it was developed for only the two coils. The bony internal auditory meatus was present but was narrowed and was filled with connective tissue central to Scarpa's ganglion. Vascular channels were seen here and in relation to the end-organs in the cochlea and vestibule. There was no evidence of the seventh nerve anywhere in its normal position, nor of the geniculate ganglion or chorda tympani nerve. In the region where the petrosal nerves might be expected there were two connective tissue channels in the bony tissue in which nerve fibers could be seen. Off the apex of the cochlea several ganglion cells were found, and at the

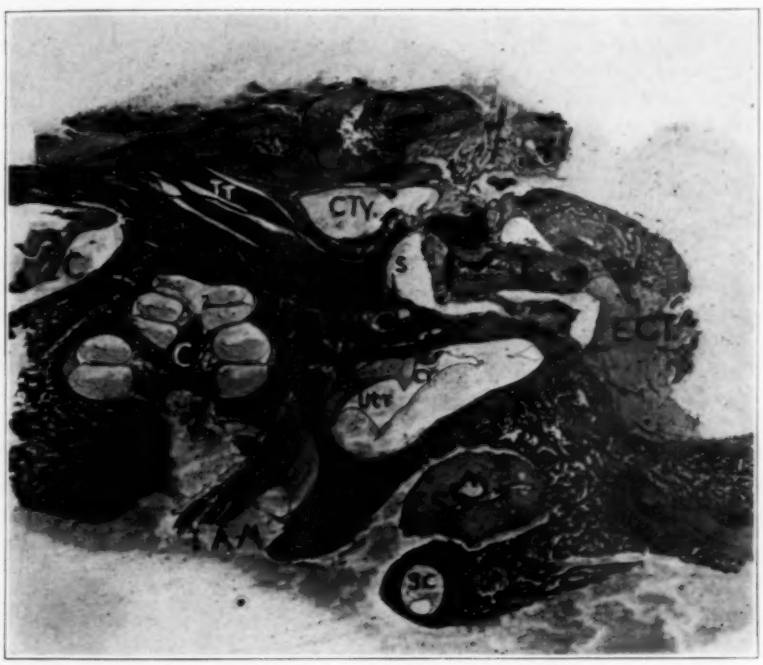

Fig. 7.—Right, horizontal. *IC* is the internal carotid artery; *TT*, the tensor tympani muscle; *CTy*, the cavum tympani; *M*, the malleus; *I*, the incus; *ECt*, the embryonic connective tissue in the antral region; *S*, the seventh nerve; *C*, the cochlea; *Utr*, the utricle; *Cr*, the crista of the horizontal canal; *IAM*, the internal auditory meatus; *FS*, the fossa subarcuata; *SC*, the superior canal; × 6.

anterior end of the petrous bone ganglion cells were noted in each tract of fibers. The more lateral one contained a prominent triangular nest of ganglion cells. The ductus and saccus endolymphaticus and the aqueductus cochlearis were apparently present, although they were not as definitely seen as on the other side.

Microscopic sections of the right or normal ear showed no congenital abnormalities (fig. 7). The drum membrane, ossicles, tensor tympani and stapedius muscles, chorda tympani and facial nerves were normal. The mucous membrane of the cavum tympani and eustachian tube was still partly embryonic. In the region about the ossicles and the fossa for the fenestra cochlea there were much blood and

purulent material. The region of the antrum was filled in with embryonic connective tissue with numerous blood vessels and considerable extravasated blood. The end-organs of the cochlea, utricle and saccule, the three canals and the two divisions of the eighth nerve with the ganglions were normal. A small mass of red blood cells was seen in the saccule. The ductus and saccus endolymphaticus and the aqueductus cochlearis appeared normal. A large focus of cartilage was seen in the posterior portion of the petrous bone, posteromedial to the vestibule and canals.

Gross examination of the brain showed no general asymmetry on the two sides. On the left side in the region of the emergence of the seventh to the twelfth nerves it was apparent that there were fewer fibers than on the right or normal side. However, it was impossible to identify the individual nerve roots on the involved side. Microscopic sections of the brain revealed several points of interest. The complete examination of this material will be reported separately by Dr. O'Leary, while in the present report only the major findings relating to the ear will be given. On the right or normal side the nuclei and tracts of the fifth to the eighth nerves, inclusive, were normal. On the left or malformed side the fifth and sixth nerves were also normal. However, the seventh and eighth nerves showed malformations. The motor nucleus of the seventh nerve was practically absent, only a few cells being seen. The emergent portion of the seventh nerve did not reach the surface of the brain, and what was present consisted of a narrow strand. Peculiarly, the sensory part of the nerve seemed developed beyond normal, and its fibers became external. The vestibular nuclei and tracts were present, but were smaller than normal. The dorsal and ventral cochlear nuclei were practically absent, only a few cells being noted. The region of the nuclei was present, but the tissue appeared to consist of degenerated material. No cochlear fibers were seen emerging from the brain on this side.

COMMENT

From a clinical standpoint the case presents several points of interest. It has been stated that when there is a deformity of the outer ear, the inner ear is usually normal, and vice versa. However, in this case there was a deformity all through the apparatus of the ear. In cases of malformation of the outer ear the question of plastic operation arises, both for cosmetic purposes and for possible improvement in hearing. The present report shows the folly of attempting to better the hearing in a case of this type. Probably, had the child lived, a roentgenogram of the ear would have shown the absence of an external auditory canal and the almost complete absence of the internal auditory meatus, which would have forewarned the surgeon of likely deformity of the inner ear. There are those, of course, who do not operate on unilateral deformities; the present case demonstrates how important it is to study the condition as carefully as possible before operating.

The malformations of the membrana tympani, cavum tympani, malleus, incus, stapes and stapedius muscle are not sufficiently unusual to warrant extended comment except to state their condition. The presence of thymus tissue in the cavum tympani is exceptional. Evidently it is possible for the thymus anlage to be so closely related to the first pouch as to be carried up into the ear. As ordinarily

described, it arises only as high as the third pouch in man and the second in some of the lower forms. The patient's thymus was normally located in the chest. I have found no previous record of a thymus having been noted in the ear.[1] There was also thymus tissue attached to the thyroid gland. The presence of purulent material in the middle ear on each side is to be noted. Its significance is still a question.

The absence of the seventh nerve on the involved side is of unusual interest. In some reports an anomalous course for the seventh nerve has apparently been found. In others, the nerve has been present in part, ending blindly somewhere in the facial canal. Cases of paresis of that side of the face have been noted. In view of the practical absence of the motor seventh nucleus and the lack of fibers from it external to the brain, it is evident that the facial nerve was not present on this side. However, the baby showed no signs of facial paresis and took nourishment without difficulty.

The nerve elements found lateral to the apex of the cochlea and running anteriorly in two tracts simulated the petrosal nerves. The few ganglion cells found near the cochlea could not be definitely recognized; possibly they were related to a malformed geniculate ganglion. The large group of cells found at the anterior end of the more lateral tract was also impossible of identification. These might also be a part of a malformed geniculate ganglion.

While the cochlea consisted of only two coils and the spiral ganglion and its fibers were absent, yet the organ of Corti was normally developed.

Material has been presented to show that impulses from the auditory pathways are necessary in order that the cochlea may develop. Therefore, it would seem apparent that in the beginning the cochlear nerve was connected with the cochlea. Subsequently, the spiral ganglion and its fibers degenerated. Correlated with this is the finding that the dorsal and ventral nuclei of the cochlear nerve show definite evidence of degeneration. It is significant that, associated with the absence of the spiral ganglion and the cochlear root, the cochlear nuclei are so highly degenerated.

In regard to the vestibular apparatus, the end-organs were found normal. Scarpa's ganglion and the peripheral nerve fibers were present but in diminished number. Likewise, the vestibular nuclei and tracts in the base of the brain were present, but also apparently diminished in number. The normal appearance of the cells of Scarpa's ganglion and those cells lateral to the apex of the cochlea, in spite of no connection with the brain by way of the internal auditory meatus, allows of considerable speculation.

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1. In a personal communication with Professor Hammar of Uppsala, he stated that to his knowledge, a thymus had not been previously found in the middle ear.

CONCLUSION

A case of unilateral malformation of the auditory apparatus is presented. On the left, or involved side, the outer ear, external canal and drum membrane were absent. The malleus, incus and stapes were deformed. The tensor tympani muscle was present, but the stapedius muscle was absent. A mass of thymus tissue was situated in the cavum tympani. The facial nerve was absent, and in the place of its usual third and fourth portions were two abnormal veins. The end-organs of the cochlear and vestibular apparatus were normally developed. However, there was no spiral ganglion or cochlear nerve tissue, although Scarpa's ganglion and the nerve fibers to the end-organs were partially present. The internal auditory meatus was narrow, and its aperture was filled with connective tissue so that there was no nerve connection with the brain. Of the nuclei at the base of the brain, the cochlear nuclei of the eighth and the motor nucleus of the seventh nerve were practically absent. The vestibular nuclei and tracts were present but diminished in number, while the sensory part of the seventh nerve was larger than normal. The ear and its connections were normal on the right side.

Dr. M. E. Davis of the Chicago Lying-In Hospital aided in obtaining the autopsy, and Dr. G. W. Bartelmez of the University of Chicago helped in the study of the case.

PARANASAL SINUSITIS

OPAQUE DISPLACEMENT DIAGNOSIS

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PHILADELPHIA

From 1925 to 1927, Proetz [1] and Frazer [2] independently introduced a new displacement or insuffusion procedure in the diagnosis and treatment of sinusitis. The method is simple and logical and yet quite revolutionary in its principle of examining and treating the paranasal sinuses.

In view of the complicated anatomy and individual anomalies of the paranasal sinuses, the displacement method is ideal providing the inoculum, as iodized poppy seed oil, could be always successfully introduced into these regions. However, it is not possible to expect a satisfactory result in every case, since the displacement of air in the sinuses may be prevented by obstructive complications such as nasal polypi, hypertrophied turbinates or closed ostia, which are so frequently observed in paranasal sinusitis.

I undertook a study of the efficiency of opaque displacement methods with special reference to a modification, in the diagnosis and treatment [3] of paranasal sinusitis, and the results are summarized herewith.

REPORT OF CASES

Twelve cases of paranasal sinusitis and one of ozena were included in this study. The accompanying table summarizes the differences in

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Submitted for publication, Dec. 28, 1931.

From the Department of Otolaryngology, the Graduate School of Medicine of the University of Pennsylvania.

Thesis (Part III of thesis work) submitted to the Faculty of Otolaryngology of the Graduate School of Medicine of the University of Pennsylvania in partial fulfilment of the requirements for the degree of Doctor of Medical Science (D. Sc. [Med.]) for graduate work in Otolaryngology.

1. Proetz, A. W.: Displacement Irrigation of Nasal Sinuses: A New Procedure in Diagnosis and Conservative Treatment, Arch. Otolaryng. **4**:1 (July) 1926; Further Data on the Displacement Method in Sinuses, Ann. Otol., Rhin. & Laryng. **36**:297 (June) 1927; The Displacement Method of Sinus Diagnosis and Treatment, St. Louis, Annals Publishing Company, 1931.

2. Frazer, R. H.: Die Kontrastfüllung in der oto-laryngologischen Diagnostik, Monatschr. f. Ohrenh. **61**:802, 1927.

3. Amano, K. W.: Paranasal Sinusitis: Local Immunization Treatment, Arch. Otolaryng. **14**:30 (July) 1931.

the results of roentgenographic examinations with and without the administration of iodized oil. The result of diagnosis is recorded in the table, first, by the ordinary roentgenogram (X), showing the probable grade of infection in the sinuses, and, second, by the roentgenogram (PM) after the administration of iodized oil by the Proetz method, showing the approximate infiltration of this substance into the sinuses.

Results of Roentgenographic Examinations With and Without the Administration of Iodized Oil *

Case	Diagnosis		Frontal Sinus		Ethmoid Sinus		Sphenoid Sinus		Maxillary Sinus	
			X	PM	X	PM	X	PM	X	PM
1	Ethmoiditis chronica; rhinitis hypertrophica	R	..	..	+	++, ++	−?	−, +	−?	+, +
		L	..	..	+	−, −	−?	+, +	−?	−, +
2	Ethmoiditis chronica; rhinitis hypertrophica	R	..	..	++	−	−	−	−	−
		L	..	..	+	−	−	−	−	−
3	Ethmoiditis chronica; dacryocystitis chronica	R	−	−	+	−	−	−	−?	−
		L	−	−	−	+	−	−	−	−
4	Sinuitis maxillaris chronica; deviatio septi nasi	R	−	−	+	+	−?	−	−	−
		L	−	−	+	+	−?	−	++	−
5	Rhinitis atrophica (ozena)	R	−	−	−?	+	−	+	−	−
		L	−	−	−?	+	−	+	−	+
6	Sinuitis maxillaris chronica; rhinitis atrophica	R	−	−	−	+, −	−?	−, −	++	−, −
		L	−	−	+	+, +	−?	−, −	+	+, +++
7	Ethmoiditis chronica; rhinitis atrophica	R	..	..	++	−	−?	−	+	+
		L	..	..	++	−	−?	+	−	+++
8	Ethmoiditis chronica; rhinitis catarrhalis	R	..	..	+?	−	−?	+	−?	+
		L	..	..	+?	−	−?	+	−?	−
9	Ethmoiditis chronica; sinuitis frontalis	R	+	+	+	+	+	+++	+	+
		L	+	−	+	+	+	++	+	−
10	Ethmoiditis chronica; rhinitis catarrhalis	R	−	−	+	−	−	−	+	−
		L	−	−	+	−	−	−	+	+
11	Ethmoiditis chronica; rhinitis catarrhalis	R	−	−	−	+	−	++	−	+
		L	−	−	−	+	−	++	−	+
12	Ethmoiditis acuta; rhinitis catarrhalis	R	−	−	+	++	−	+	−?	+
		L	−?	−	+	+	−	+	−	+
13	Ethmoiditis chronica dextra	R	−	−	+	+	−	−	+	+
		L	−	+	+	+	−	−	−	−

* In the table, the results are interpreted as follows:

X, Without Iodized Oil		PM, With Iodized Oil
Slightly cloudy or hazy	+	Iodized oil slightly entered
Cloudy with thickened membrane or pus	++	Iodized oil freely entered
Cloudy more extensively with polypi or pus	+++	Iodized oil filled the space
Fairly clear	+?	
Clear or normal	−	Iodized oil not entered
Not as it should be	−?	

R, right; L, left.

The Proetz method here applied is that of the supine position, which is originally and chiefly described by Proetz, excluding the prone one.

Case 1.—R. G., a white woman, aged 36, was seen on July 18, 1929, with a condition diagnosed as ethmoiditis chronica; rhinitis hypertrophica. The symptoms were nasal discharge and headache.

Examination.—The turbinates were catarrhal and hypertrophied, except the left middle turbinate, which had been removed three years previously. Irrigations of both antrums gave negative results.

Roentgenography.—Both ethmoids were cloudy. Iodized oil was introduced by the Proetz method into the right ethmoid and partially into the sphenoids and maxillaries (fig. 1).

Criticism.—The ethmoids must have been the source of the nasal discharge and headache. Removal of the right middle turbinate seemed to favor the entrance of iodized oil into the ethmoid. The patient complained of headache in the left orbital region, which might have been due to the unsatisfactory drainage of the left ethmoid.

CASE 2.—J. C., a white man, aged 65, married, was seen on July 18, 1929.

Diagnosis.—Ethmoiditis chronica; rhinitis hypertrophica.

Symptoms.—Headache, nasal discharge.

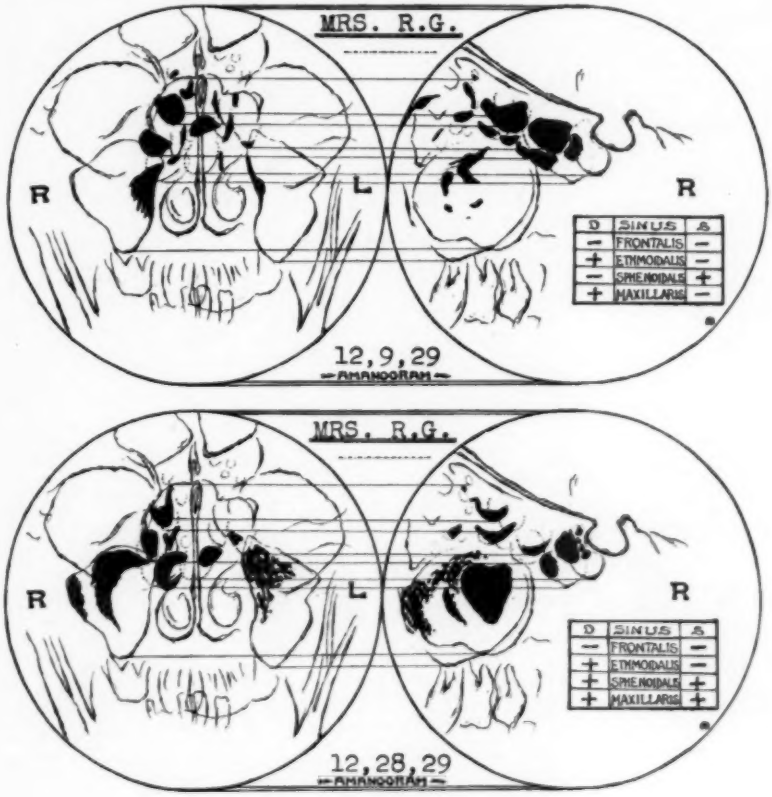

Fig. 1 (case 1).—Roentgenologic pictures.

Examination.—Turbinates hypertrophied and catarrhal. Septum irregular and catarrhal. Mucous membrane covered with mucus discharge. Antral irrigations both negative.

Roentgenography.—Ethmoids hazy, especially on the right side. Iodized oil by the Proetz method entered none of the sinuses.

Criticism.—The reason for the negative results of the administration of iodized oil by the Proetz method seems to be due to the hypertrophied condition of all turbinates, which probably close the ostia, thus causing headache.

Case 3.—P. S., a white man, aged 25, single, was seen on March 6, 1929.

Diagnosis.—Ethmoiditis chronica; dacryocystitis chronica dextra.

Symptoms.—Nasal discharge, difficulty in breathing.

Examination.—Turbinates slightly hypertrophied. Septum irregularly deflected. Mucous membrane red and catarrhal. Antral irrigations both negative.

Roentgenography.—Cloudiness on the right ethmoid. Iodized oil entered only the left ethmoid. Other sinuses clear.

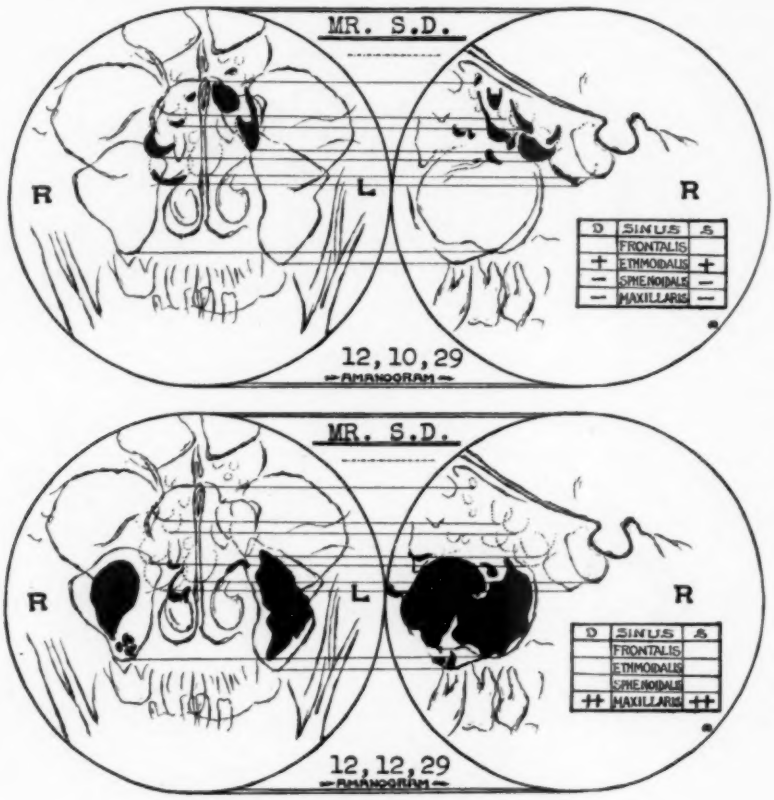

Fig. 2 (case 4).—Roentgenologic pictures.

Criticism.—No iodized oil entered the diseased side of ethmoid, which was complicated by dacryocystitis. The left ethmoid filled with iodized oil seems normal.

Case 4.—S. D., a white man, aged 21, single, was seen on Nov. 18, 1929.

Diagnosis.—Sinuitis maxillaris and ethmoiditis chronica; deviatio septi nasi.

Symptoms.—Purulent nasal discharge, headache, nasal obstruction.

Examination.—Nasal mucous membrane catarrhal and covered with pus discharge.

Septum irregularly deflected, which seems to cause the obstruction.

Antral irrigations negative (fig. 2).

Roentgenography.—Both ethmoids and left antrum cloudy. Iodized oil by Proetz method entered only the ethmoids. Antral injections of iodized oil showed evidence of moderately thickened membrane.

Criticism.—The ethmoids which show cloudiness seem to have good drainage, judging by the penetration of iodized oil. The left antrum which was operated on (the Caldwell-Luc operation, on Feb. 11, 1930) showed a thickened membrane. Submucous resection performed on Jan. 23, 1930. The patient apparently recovered.

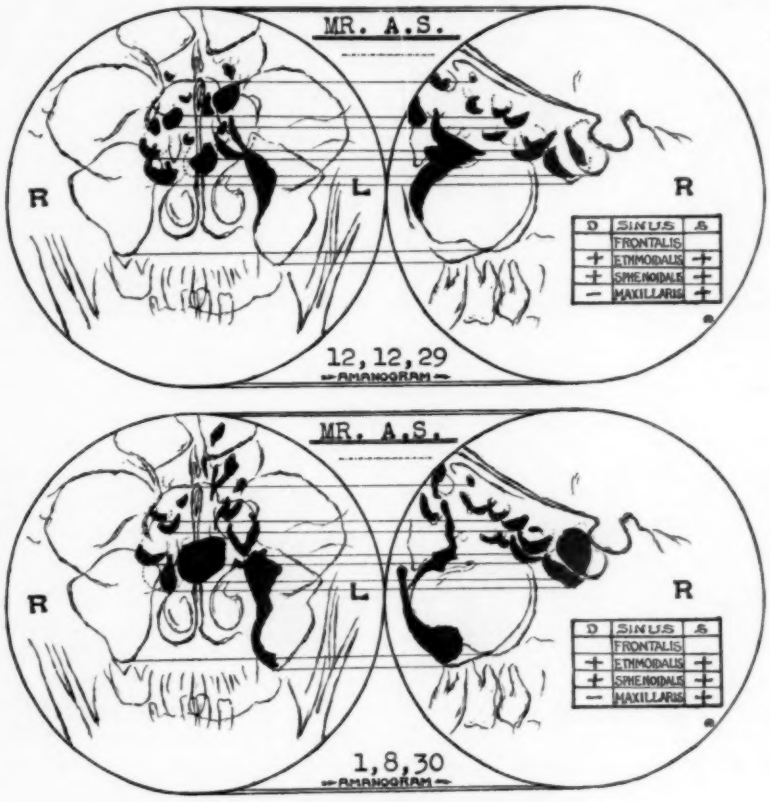

Fig. 3 (case 5).—Roentgenologic pictures.

CASE 5.—A. S., a white man, aged 38, single, was seen on Nov. 17, 1920.

Diagnosis.—Rhinitis atrophica foetida (ozena).

Symptoms.—Dryness, crust formation, occasional obstruction of nose.

Examination.—Turbinates atrophied and covered with thick pus. Middle turbinates ulcerated. Septum perforated (postoperative). Antral irrigations both negative. Wassermann reactions (Kolmer and Kahn) negative.

Roentgenography.—Both ethmoids suspected of infection. Other sinuses clear. Iodized oil by the Proetz method entered the ethmoids, sphenoids and left antrum (fig. 3).

Criticism.—Fair result of administration of iodized oil may be due to the atrophied condition of the nasal turbinates. The sinuses are apparently free from infection, or well drained.

CASE 6.—C. L., a white boy, aged 11, was seen on Oct. 21, 1929.

Diagnosis.—Sinuitis maxillaris chronica; rhinitis atrophica foetida.

Symptoms.—Crust formation and slight obstruction of nose.

Examination.—Both middle turbinates moderately hypertrophied, while the inferior slightly atrophied. Nasal cavity covered with thick yellowish pus, which had

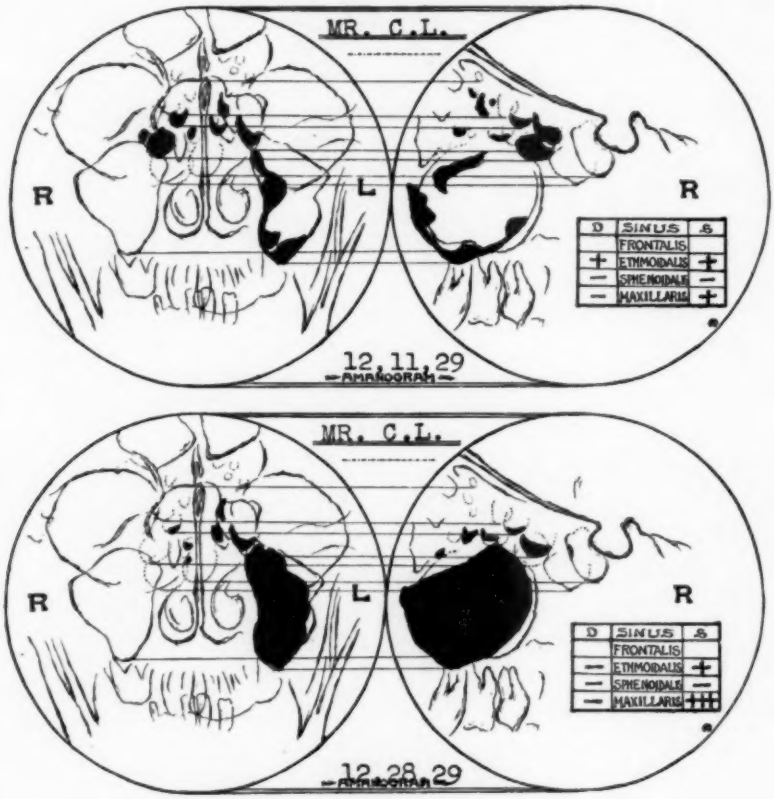

Fig. 4 (case 6).—Roentgenologic pictures.

a characteristic odor. Antral irrigation, a great amount of yellowish pus on the right side, and a little mucus on the left. Wassermann reactions (Kolmer and Kahn) negative.

Roentgenography.—The left ethmoid and both antra very cloudy, especially the right. Iodized oil entered the ethmoids, left sphenoid and left antrum, but not the right (fig. 4).

Criticism.—The result of the administration of iodized oil shows fair drainage of the ethmoids in spite of severe infection. The atrophied condition of the nasal cavity seems to favor the filling of the antrum by iodized oil, except on the right

side, which is probably filled with polypi and pus. The fair drainage of ethmoids may be the reason of the absence of headache and pain.

CASE 7.—A. C., a white girl, aged 15, was seen on Feb. 27, 1929.

Diagnosis.—Ethmoiditis chronica; sinuitis frontalis.

Symptoms.—Headache and nasal discharge.

Examination.—All turbinates somewhat atrophied and covered with purulent discharge. Yellowish pus in the middle meatus.

Roentgenography.—Both ethmoids are cloudy and show the diseased condition of the cells. Sphenoids and maxillaries doubtful. Right antrum is more hazy. Iodized oil entered the left sphenoid and both antrums, especially the left, which was filled with a great amount of the substance.

Criticism.—Ethmoid infection may be the cause of the trouble. Iodized oil in the antrums may be favored by the atrophied condition of the nose and free discharge of sinuses. The negative result of iodized oil in the ethmoids as well as the rhinoscopic examination suggests a grave condition.

CASE 8.—S. Y., a white woman, aged 35, married, was seen on July 19, 1929.

Diagnosis.—Ethmoiditis chronica; rhinitis catarrhalis.

Symptoms.—Nasal discharge, postnasal dripping, occasional headache.

Examination.—Nasal mucous membrane catarrhal and red with mucus discharge.

Turbinates not hypertrophied. Antral irrigation, both negative.

Roentgenography.—Ethmoids somewhat cloudy. Other sinuses apparently clear. Iodized oil entered both the sphenoids and right antrum.

Criticism.—Ethmoids are probably the only infected regions. The negative result of iodized oil may be due to the closure of the ostia. Iodized oil shows almost no evidence of infection in the sphenoids.

CASE 9.—R. P., a white girl, aged 16, was seen on Feb. 21, 1929.

Diagnosis.—Ethmoiditis chronica; sinuitis frontalis.

Symptoms.—Great amount of purulent nasal discharge, frequent headache, nasal obstruction.

Examination.—Ear, chronic otitis media, with subnormal hearing. Nose, both middle and inferior turbinates are hypertrophied. Right middle turbinate removed a year ago; the region shows polypoid granulation.

Roentgenography.—Frontal, ethmoids and maxillaries are all cloudy. Iodized oil by the Proetz method entered the right frontal, ethmoid, sphenoid and left antrum.

Criticism.—By the administration of iodized oil, the right frontal sinus showed no sign of thickened membrane; but the left frontal looked suspicious. The other sinuses except the right antrum appear fairly healthy. The removal of the right middle turbinate seems to favor good drainage of the ethmoids and also the frontal; but the ethmoids are badly infected.

CASE 10.—M. S., a white woman, aged 38, married, was seen on Aug. 12, 1929.

Diagnosis.—Ethmoiditis chronica; rhinitis catarrhalis chronica.

Symptoms.—Headache, difficulty in breathing, great amount of watery discharge from the nose.

Examination.—Both middle turbinates moderately hypertrophied. Small polypi in both middle meati. Mucous membrane catarrhal. Antral irrigation, both negative.

Roentgenography.—Ethmoids cloudy. Maxillaries hazy. Iodized oil by the Proetz method failed to enter any sinus, except the left antrum, where a small amount was found.

Criticism.—The hypertrophy of both middle turbinates and the formation of polypi may have obstructed the entrance of iodized oil. The patient's condition improved greatly after the polypi were removed. No examination with iodized oil after the polypotomy was performed.

CASE 11.—L. T., a white woman, aged 21, single, was seen on Jan. 21, 1927.

Diagnosis.—Ethmoiditis chronica; rhinitis catarrhalis chronica.

Symptoms.—Nasal obstruction, watery discharge, occasional headache.

Examination.—Mucous membrane catarrhal and red, covered with mucus. Not especially hypertrophied.

Roentgenography.—All sinuses negative. Iodized oil entered the ethmoid, sphenoid and maxillary sinuses fairly well, especially the sphenoid.

Criticism.—The good drainage of all sinuses may have been the reason, for the negative finding by x-ray, both with and without the administration of iodized oil. However, subacute or recurrent infiltration of the ethmoid was suspected.

CASE 12.—J. S., a white man, aged 45, single, was seen on Jan. 24, 1930.

Diagnosis.—Ethmoiditis acuta; rhinitis catarrhalis subacuta.

Symptoms.—Difficulty of nasal breathing, nasal discharge, headache.

Examination.—All turbinates are slightly hypertrophied and catarrhal, covered with mucous secretion. Septum irregular.

Roentgenography.—Ethmoids are cloudy. Other sinuses in fair condition. Iodized oil entered all sinuses, the ethmoid, sphenoid and maxillary.

Criticism.—The condition is rather acute, and the drainage seems good. The congenital defect of irregular septum and the acute condition of the ethmoidal infection may be the main cause of the complaints.

CASE 13.—H. F., a white woman, aged 25, was seen on Jan. 27, 1930.

Diagnosis.—Ethmoiditis chronica dextra.

Examination.—Both right middle and inferior turbinates are hypertrophied and slightly catarrhal.

Roentgenography.—Both ethmoid and right antrum cloudy. Iodized oil entered the left frontal, both ethmoids and right antrum.

Criticism.—The inflammation seems recurrent, but the roentgenographic and clinical examinations show a slight degree of infection.

In reviewing these cases, it is evident that the failure of the administration of iodized oil to outline the sinuses by the Proetz method is chiefly due to complications in the nasal cavity. For instance, two roentgenograms taken in case 1, copied as figure 1, demonstrate how the hypertrophied turbinates on the left side inhibit the infiltration of iodized oil into the ethmoid cells, while the removal of the middle turbinate on the other side brings the contrary result. The free and better infiltration of iodized oil is usually observed in the atrophic condition of the nasal cavity, as shown in figure 3, drawings of the roentgenograms taken in case 5.

The maxillary sinuses are not ordinarily successfully outlined by the administration of iodized oil by the Proetz method, while the puncture method gives better results in these regions, as shown in figure 2, drawings of the roentgenograms taken in case 4. But the atrophic condition of the nasal cavity sometimes permits the medium to enter these sinuses, as observed in figure 4, drawings of the roentgenograms taken in case 6. The right antrum was filled with thick purulent material and thereby prevented the access of iodized oil.

The sphenoid sinus is most favorable for the administration of iodized oil by the Proetz method. The ethmoid sinus is next, especially the posterior cells. The maxillary sinus is still less favorable,

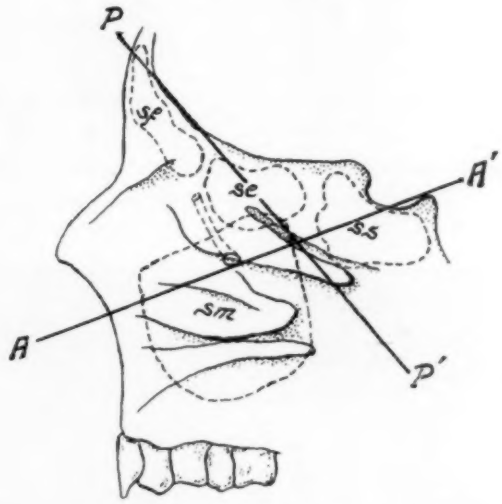

Fig. 5.—The Proetz method and its modification in the anatomic relations with the paranasal sinuses. *P—P'* is horizontal line for the Proetz method; *A—A'*, the same for the modified method; *sf* indicates the sinus frontalis; *se*, the sinus ethmoidalis; *ss*, the sinus sphenoidalis, and *sm*, the sinus maxillaris.

except in special cases. The frontal sinus is least favorable and is of practically no interest from this standpoint.

MODIFIED METHOD

In my hands, the Proetz method proved to be of little or no value for outlining the frontal and maxillary sinuses. In view of the anatomic situation of these sinuses (fig. 5), I agree with Frazer and Proetz that the prone position for the displacement method to the frontal and anterior ethmoid sinuses gives a better infiltration of these areas.

However, the position of the patient that I recommend is a far advanced prone one considerably greater than that of Frazer's "prone

plus 30 degrees" [4] or Proetz' "flat prone" position, stretching and hanging down the head at the edge of a table. The technic is, then, that first described by Proetz for his method. The nasal tip of a rubber tube attached to the suction apparatus that is used by Frazer is more convenient than the Proetz syringe. This position may not be comfortable for a fat person with a short neck. To avoid this difficulty and also to simplify the principle of this method, it is recommended

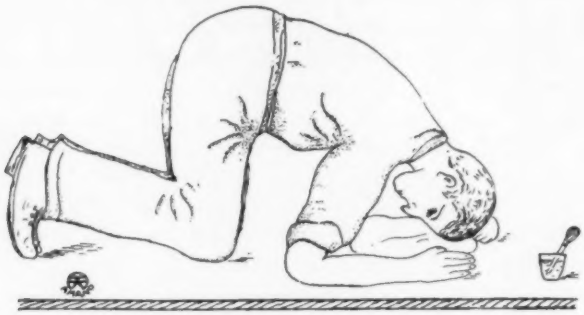

Fig. 6.—The knee-chest position for the modified method.

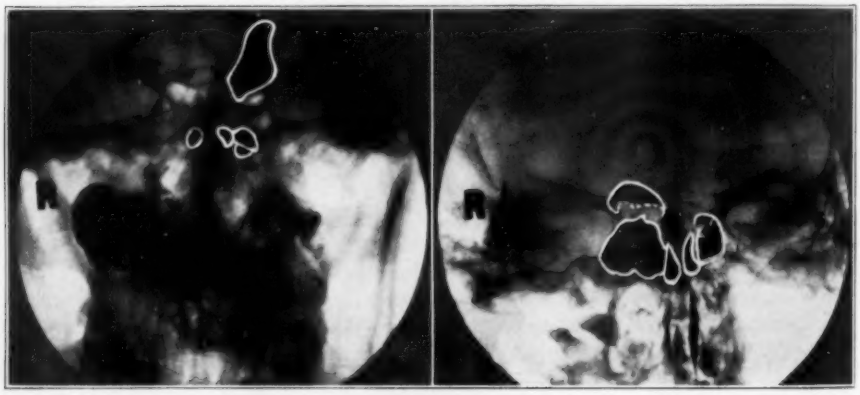

Fig. 7 (case 6).—Roentgenologic pictures.

that the knee-chest position, as sketched in figure 6, be employed. This position is almost like that which Goodyear [5] applied in his work with his injection method.

I have observed better results by this modified position (fig. 7), especially for outlining the frontal and ethmoid sinuses, while the Proetz

4. Frazer, R. H.: Diagnostic Uses of Lipiodol in the Paranasal Sinuses, Radiology **12**:6 (Jan.) 1928.

5. Goodyear, H. M.: Use of Iodized Oil in Diagnosis of Nasal Sinus Conditions: Further Observation, J. A. M. A. **95**:1002 (Oct. 4) 1930.

method followed by this modification is adopted for all the sinuses, in order to obtain better results in the diagnosis and treatment of diseases of the paranasal sinus. The iodized oil is used as 50 per cent diluted with olive oil.

CONCLUSIONS

1. The roentgenographic examination of the nasal sinuses following the administration of iodized oil by the displacement method furnishes additional information as to whether the drainage from the ostia is satisfactory, or whether the sinuses or cells are filled with thickened membrane or pus. Negative results after the administration of iodized oil, however, do not always exclude the possibility of diseases.

2. The practical value of the opaque displacement method in the diagnosis and treatment fluctuates according to nasal complications, such as hypertrophied turbinates, especially the middle turbinates, and polypi. The removal of these obstructions should be advised before the final roentgenographic examination by the displacement method.

3. The results of the administration of iodized oil by the Proetz method only in his supine position are more accurate in the case of the ethmoid and sphenoid sinuses than in the case of the maxillary and frontal sinuses. For the maxillary sinuses, the iodized oil should be injected by puncture through the inferior meatus or by cannula through the natural ostium.

4. The advanced prone or knee-chest position of the displacement method described by me is recommended, after the Proetz method with the supine position is practiced, in order to give better results in the administration of iodized oil, especially into the frontal sinuses and the anterior ethmoid cells.

SUPPURATION OF THE PETROUS PYRAMID

REPORT OF TWO CASES

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The recent papers of Eagleton and of Kopetzky and Almour [1] on suppuration in the petrous pyramid have called to the attention of the otologist a condition that undoubtedly has been responsible for many failures in operations on the mastoid processes. Eagleton's [2] recognition and description of the symptoms associated with the condition are significant, and will be of use in preventing untoward complications of mastoiditis.

We are reporting two cases in which the condition was recognized by the use of these diagnostic criteria, and wish to suggest that in some of these cases, at least, any alterations in the usual technic of mastoidectomy may be unnecessary.

CASE 1.—A girl, aged 8 years, was brought to the Mayo Clinic with the history that six weeks previously drainage from the ears had developed following acute infection of the upper part of the respiratory tract. The acute otitis media of the right ear underwent resolution without incident. Drainage from the left ear continued, and three weeks after the onset of the otitis media, severe pain appeared back of the left eye, and at intervals radiated over the vertex. The pain was still present on the patient's admission, but it had become less intense. With the onset of the headache, the patient's mother noticed that the child tended to keep the left eye closed and avoided bright light. She also complained that the left cheek felt "fat," and frequently she bit the inside of the cheek while eating. Motor paralysis of the face had not been noted, however. Three weeks before admission mastoidectomy had been performed on the left side. Profuse discharge followed, and on the sixth day paralysis of the left external rectus muscle of the eye was noted, which had persisted. Lumbar puncture a week before the patient came to the clinic gave negative findings.

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From the Section on Otolaryngology and Rhinology, the Mayo Clinic.

1. Kopetzky, S. J., and Almour, Ralph: The Suppuration of the Petrous Pyramid: Pathology, Symptomatology and Surgical Treatment; I. Introduction; Anatomic and Pathologic Data; II. Symptomatology; III. Surgical Therapy; IV. Case Reports, Ann. Otol., Rhin. & Laryng. **39**:996 (Dec.) 1930; **40**:157 (March); 396 (June); 922 (Sept.) 1931.

2. Eagleton, W. P.: Unlocking of the Petrous Pyramid for Localized Bulbar (Pontile) Meningitis Secondary to Suppuration of the Petrous Apex: Report of Four Cases with Recovery in Three, Arch. Otolaryng. **13**:386 (March) 1931.

Examination revealed nothing of significance in the ear, nose and throat except the discharge from the external auditory canal and the postauricular wound on the left side. The eyes were normal except for the complete paralysis of the left external rectus muscle. No other data were suggestive of involvement of the central nervous system.

A roentgenogram of the mastoid processes revealed cloudy shadows on the left with a cellular petrous pyramid and extension of the cloudiness into the air cells of the petrosa of the involved side. A diagnosis of inflammation of the petrosa and acute otitis media was made in view of the presence of the syndrome of involvement of the petrous pyramid as recently reported, and exploration of the mastoid process and petrous pyramid was advised.

At operation, it was found that the mastoid cells had been completely exenterated except for a few above and anterior to the middle ear. These were opened and were found to extend toward the petrous pyramid. They were followed mesially above the knee of the carotid artery and anterior to the cochlea and labyrinth capsule by advancing immediately below the superior wall of the petrous pyramid. The petrous pyramid was penetrated to a depth of about 2.5 cm. from the zygomatic root. This approach to the petrous pyramid was similar to that described by Almour, but we found it unnecessary to perform a radical mastoidectomy, the zygomatic portion of the anterior wall of the canal being removed in the exenteration of the cells.

The pain in the head improved almost immediately, and by the end of the fourth day the patient could draw the left eye well beyond the median line to the left. She was dismissed from the hospital after two weeks with complete recovery of mobility of the eye, but the postauricular wound was somewhat slow in closing, although the discharge was minimal and the middle ear appeared normal and free from discharge.

Case 2.—A girl, aged 17, gave the history that following severe infection of the upper part of the respiratory tract three months previously her left ear pained for a time, then ruptured spontaneously, after which it began to discharge, and this was still profuse at the time of admission. Nine weeks after the ear began to discharge, the patient noticed a severe aching pain back of the left eyeball with occasional radiations of pain over the occipital and parietal regions. A week before her admission she had noticed stiffness of the neck on turning her head to the right.

Examination disclosed such marked drooping of the posterior superior wall of the external auditory canal that the drum could not be seen. The canal was filled with thick, greenish pus which rapidly returned on being wiped away. There was some tenderness on firm pressure over the region of the emissary vein of the mastoid on the left. There were no other relevant findings concerning the ear, nose or throat.

The patient was rather undernourished, and well compensated mitral regurgitation was present. There were no symptoms suggestive of involvement of the central nervous system. The stiffness of the neck was subjective, and was due to pain on tensing the sternocleidomastoid muscle. Compound hypermetropic astigmatism was noted; the external ocular muscles and fundus were normal. A roentgenogram of the mastoid processes showed cloudiness of the cells of the left mastoid with absorption of the cells at the tip. A roentgenogram of the petrous pyramid showed marked invasion with pneumatic cells on both sides. The pneumatization of both petrous pyramids could be clearly made out, likewise the definite cloudiness of the air cells of the petrosa on the left. The relatively large space between the labyrinth capsule and the posterior wall of the petrous pyramid could be clearly seen, those of the left petrous pyramid being markedly

cloudy. The air cells seemed to penetrate the petrous pyramid on its posterior aspect, and apparently a considerable space existed between the labyrinth capsule and the posterior surface of the petrous pyramid (fig. 1).

A diagnosis of subacute mastoiditis with involvement of the petrous pyramid was made, and mastoidectomy on the left side with exploration of the petrous pyramid was advised.

The cortex was sclerotic, but when the antrum was uncovered, a moderate quantity of pus escaped under pressure. The mastoid cells had to be exenterated with a gouge, as the mastoid was generally sclerotic, with occasional small areas

The petrous pyramid, with extensive pneumatization. The apparent room between the labyrinth capsule and the posterior wall of the petrous pyramid can be clearly made out.

filled with pus and infected granulations. A well developed petrosquamous lamina was found, as described by Schwartze and Eysell,[3] Closier [4] and recently by Möller.[5] When the infected cells in the antro-apical groove were exenterated,

3. Schwartze and Eysell, quoted by Closier, L.: Arch. méd. d'Angers **16**:129, 1912; quoted by Möller, J.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **26**:464, 1930.

4. Closier, L.: Étude clinique et anatomique des mastoïdites latentes, Arch. méd. d'Angers **16**:129, 1912.

5. Möller, Jörgen: Das Körnersche Septum im Warzenfortsatz, Ztschr. f. Hals-, Nasen- u. Ohrenh. **26**:464, 1930.

it was found that they led to a large cell in the tip, where the disease had exposed the sigmoid sinus at its lower turn. The tegmen and the cells in the root of the zygoma were next investigated. The tegmen was thick and sclerotic, and contained several small areas filled with pus and infected granulations interspersed among bone of ivory-like consistence. The cells in the root of the zygoma were small and did not show evidence of infection, and the limits of their extension were easily reached. The bone in the groove between the sinus plate and the tegmen mastoideum appeared solid and uninvolved, but on approaching the apex of the triangle formed by the laminae, a spurt of pus shot out, and on removing the bone more widely, an epidural abscess involving the upper turn of the sinus and the adjacent dura of the middle fossa was uncovered. The dura was covered with infected granulations over an area about 2 cm. in circumference.

The dura was uncovered in all directions until normal-appearing tissue was reached in the areas at both the upper and the lower turn of the sigmoid sinus. The opening of a line of cells extending along the posterior wall of the petrous pyramid was then found, close to the anterior border of the superior epidural abscess, and followed down into the petrous pyramid between its posterior wall and the labyrinth capsule for 2 cm. These cells contained pus and infected granulations, and finally, at the greatest depth, a spurt of pus was observed. The mastoid was closed in the usual manner, and myringotomy was performed. A culture from the wound taken at the time of the operation showed a hemolytic streptococcus.

The day after the operation the patient was completely free from the symptoms of pain back of the eye and over the occiput and the parietal region. Twenty-two days afterward she was dismissed from our care with the postauricular wound completely healed, the canal dry and the tympanic membrane appearing normal. Six months after dismissal the symptoms had not recurred.

COMMENT

The symptoms and pathologic changes incident to suppuration of the petrous pyramid have been so thoroughly considered by Eagleton and Kopetzky and Almour that recapitulation would be superfluous. However, Eagleton advised operative treatment, which he called "unlocking" the petrous pyramid, and following radical mastoidectomy he removes the "anterior and posterior buttresses," thus exposing the apex of the pyramid, which he opens with a hook. He also mentioned the possibility of a translabyrinthine approach. Following radical mastoidectomy, Kopetzky and Almour remove a portion of the anterior wall of the canal and the root of the zygoma with a burr, and approach the petrous apex above the carotid artery and anterior to the cochlea through the bone.

We have found that when well developed air cells of the petrosa are present, their development will have disturbed the usual distance relationships between the walls of the petrous pyramid and the surgically important structures it contains. If the cells develop along the posterior border of the petrous pyramid, the space between the posterior wall of the petrous pyramid and the labyrinth capsule will be increased, and if the petrous cells develop from the anterior group of cells in the region

of the eustachian tube and zygomatic root, there will be an increased relationship in space between the knee of the carotid artery, the facial nerve, the semicircular canals and cochlea and the superior wall of the petrous pyramid, and these structures will be shouldered away from one another by the development of the cells.

We feel, therefore, that the technic developed in operating on the cadaver with presumably nonpneumatized petrous pyramids is not completely applicable to surgical cases in which inflammation of the petrosa has resulted from an unusual development of the pneumatic cells. We found it possible in the two cases presented to drain adequately the infected air cells and marrow of the pyramid while conserving the important structures of the middle ear.

It has been found by one of us (Dr. Lillie) that extension of the air cells into the petrous pyramid is occasionally encountered when the cells have been involved in disease of the mastoid without producing the symptoms so clearly described by Eagleton. In following the original recommendations of Küster,[6] in which he advised the surgeon "to open up the bone freely so that it can readily be scrutinized to clear away all disease and so fully to expose the source of suppuration that the pus is nowhere checked in its outflow," such extensions are occasionally encountered, and the pyramid has been drained without knowledge of the specific symptoms of suppuration of the petrous pyramid.

If this surgical principle is followed by the surgeon, the leads into the petrous pyramid might be more frequently uncovered. Bearing in mind the probability of increased room in the operative field, the disease could thus be traced into the pyramid.

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6. Küster, E.: Ueber die Grundsätze der Behandlung von Eiterungen in starrwandigen Höhlen, mit besonderer Berücksichtigung des Empyems der Pleura, Deutsche med. Wchnschr. **15**:185 (March 7); 213 (March 14); 233 (March 21); 254 (March 28) 1889.

MALIGNANT DISEASE OF THE TONSIL

WITH SPECIAL REFERENCE TO LYMPHOSARCOMA

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Tumors of the lymphatic system are not uncommon. They are of numerous types, either benign or malignant. A study of new growths and pathologic lesions of these structures brings forth the histologic characteristics of lymphoid tissue (figs. 1 and 2). They are lymphocytes, reticulum and endothelial cells. The most prevalent lesion developing from this tissue is the benign lymphoma. Another condition is that known as the leukemias. Many classifications have been formulated in regard to changes arising from these lymphoid structures. Ewing's [1] classification is very complete. It is based on the origin, as well as on the anatomic and clinical findings. MacCallum [2] has simplified it somewhat. For all practical purposes this classification answers the need of the clinician, though probably it is not as satisfactory to the pathologist as is that of Ewing.

In a discussion of lymphosarcoma of any particular anatomic region of the lymphatic system, in this case the tonsil, a brief mention of the general subject of malignancy referable to that tissue should be considered. This is due to the close clinical and pathologic characteristics that are applicable to all malignant tumors arising from tonsillar tissue.

Irwin Moore [3] stated that primary malignant disease of the tonsil is infrequent. He expressed the belief that the condition is usually a squamous cell epithelioma (fig. 3). In his opinion, sarcoma is very rare. Sir St. Clair Thomson [4] and Douglas Guthrie [5] agreed with this view. The latter author, in a brief but comprehensive review, attempted to analyze a series of eighty cases. Of these, three were under

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From the Department of Oto-Rhino-Laryngology of the Stanford University Medical School.

1. Ewing, James: Neoplastic Diseases, ed. 3, Philadelphia, W. B. Saunders Company, 1928, p. 412.

2. MacCallum, W. G.: A Textbook of Pathology, ed. 3, Philadelphia, W. B. Saunders Company, 1926, p. 832.

3. Moore, Irwin: The Tonsils and Adenoids and Their Diseases, St. Louis, C. V. Mosby Company, 1929, p. 121.

4. Thomson, St. Clair: Diseases of the Nose and Throat, London, Cassell & Company, Ltd., 1926, p. 481.

5. Guthrie, Douglas: Sarcoma of the Tonsil, J. Laryng. **33**:310, 1918.

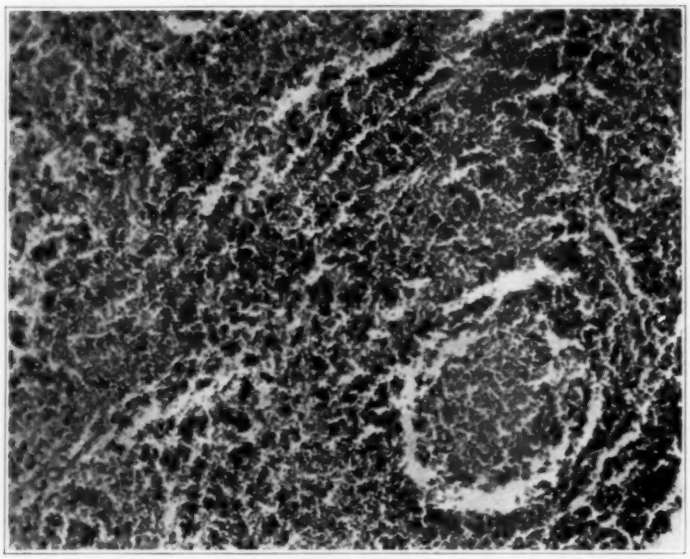

Fig. 1.—Photomicrograph of a normal lymph gland, showing lymphocytes, a few reticulo-endothelial cells and a lymph follicle with a germinal center; × 125.

Fig. 2.—Photomicrograph of a section of a nearly normal tonsil, showing the mucous membrane, lymphocytes, a lymph follicle and germinal cells; × 125. Comparison with the photomicrographs of malignant tonsil tissue, as seen in figures 3, 4, 5, 6 and 7.

his direct supervision as to diagnosis, observation and treatment. In his opinion, the condition is so rare in comparison to the malignancy in other tissues that he believes but few laryngologists see more than two or three cases during their lifetime.

Sarcoma of the tonsil occurs in any of its numerous pathologic forms. The earliest appearance is characterized by a painless lump in the throat, unilateral in character and confined for a limited period by the tonsillar capsule. Later the speech becomes thick, and the pathologic changes are manifested by dysphagia, pain and hemorrhage, with an enlargement of the glands at the angle of the jaw and the cervical region. In appearance, the tumor is a smooth, rounded,

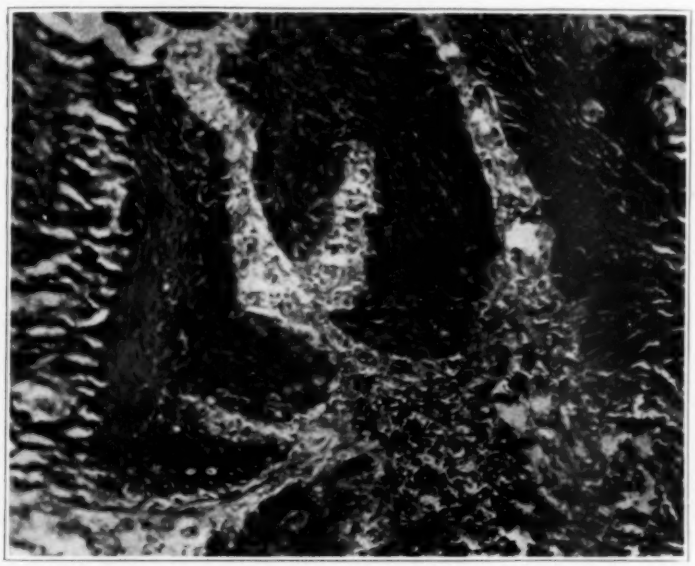

Fig. 3.—Photomicrograph of a section of a tonsil, showing epithelial cell invasion, indicative of carcinoma of the tonsil; × 125.

grayish swelling, rather slow in growth with a tendency to late ulceration. It is firm to palpation, but is softer than the epitheliomatous type. If it affects the upper pole of the tonsil, as it occasionally does it may be mistaken for a peritonsillar abscess. This mistake occurred in a considerable number of cases, as reported by Douglas Guthrie.[5] He stated that a painless quinsy of some days' duration should be viewed with suspicion.

Of the eighty cases analyzed by the previously mentioned writer,[5] thirty were too far advanced for surgical treatment. In these, palliative measures, such as the use of Coley's fluid (erysipelas and prodigiosus toxins), ligation of the external carotid, roentgen and radium

therapy and the administration of arsenic internally, were used. They all caused some temporary improvement. Operative procedures were carried out in forty-eight cases; in twenty-one, an external pharyngotomy with resection of the lower jaw was done according to the method of Mikulicz.[6] Twenty-seven patients were treated by enucleation of the tonsil by way of the mouth, with dissection of the glands of the neck at the time of operation or at a subsequent time. In most of the operative cases, a primary tracheotomy had been performed. Of thirty-seven patients who were treated, six were well with no recurrence at the end of a year. Of these six patients, three had been operated on by the method of external pharyngotomy and three by tonsillar enucleation. The investigation of Mathews[7] shows similar results. This is not an encouraging statistical prognosis when one considers the location and ease of approach.

Sir St. Clair Thomson[4] stated that sarcoma of the tonsil may occur in the following forms: (1) spindle cell, (2) round cell, (3) mixed round and spindle cell, (4) alveolar, (5) melanotic, (6) myxosarcoma and (7) lymphosarcoma.

After this brief résumé on malignancy of the tonsil, with special reference to that of sarcoma, further discussion will be confined to that particular type of lesion of the tonsil known as lymphosarcoma. Ewing[1] described it as a true malignant neoplasm arising in lymphatic tissue from a proliferation of atypical lymphocytes (fig. 4). It occurs as a localized or diffuse process. It develops from two specific types of cells, that is, the reticular cells and the lymphocytes. Until the relation of the lymphocytes to the reticular cell is fully established, the two sources of origin may be discussed together. Most observers are inclined to believe that sarcoma is prone to attack middle-aged men, though Zeidler's[8] observation at the Policlinic in Vienna is that it is most often seen in youth. Fedeli[9] reported an excellent analysis of a case occurring in a woman 52 years of age. Such varied reports lead one to believe that it may occur at any age. Chiari stated that sarcoma does not arise primarily from the tonsil, but has its origin from lymphoid tissue in the pharyngeal and cervical lymphatic regions. This observation led him to believe that it is of bacterial origin, and that it commences as a hyperplasia of the lymphoid tissues about the

6. Mikulicz, J.: Die seitliche Pharyngotomie behufs Exstirpation maligner Geschwülste der Tonsillargegend, Deutsche med. Wchnschr. **12**:157 and 178, 1886.

7. Mathews, Justus: Malignant Tumors of the Tonsil, Collected Papers of the Mayo Clinic, Philadelphia, W. B. Saunders Company, 1911, vol. 3, p. 34.

8. Zeidler, Rudolf: Lymphosarkomatose mit Lokalisation im Larynx und Trachea, Monatschr. f. Ohrenh. **63**:1038, 1929.

9. Fedeli, F.: Linfosarcoma primitivo della tonsilla, Riforma med. **37**:100, 1921.

tonsillar ring, subsequently invading the tonsil itself. Ewing [1] was inclined to disagree with this view, and he stated that from observations made at the Memorial Hospital several cases had been recognized shortly after the removal of enlarged tonsils. In reviewing the literature, one is impressed with the fact that though sarcoma may have a special predilection for the pharyngeal and cervical lymphoid structures, that is by no means the invariable rule. Many cases have been reported which clearly prove that any portion of the lymphoid chain may be primarily involved. This at times applies to the tonsil, but is especially true of the abdomen, thorax and cervical lymphatics.

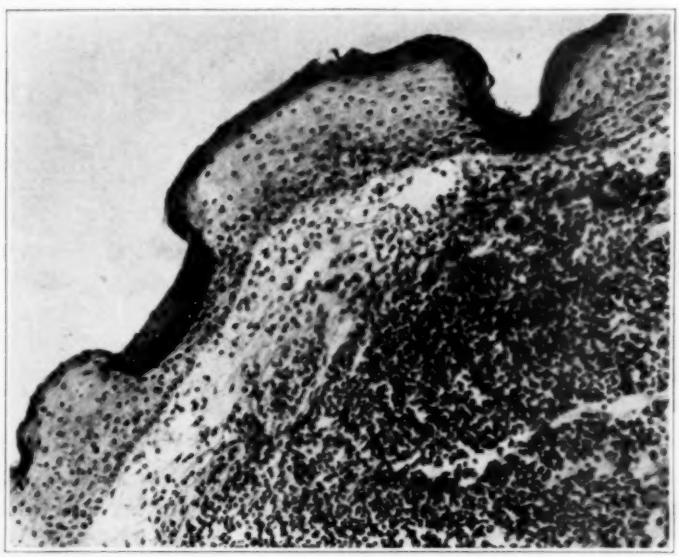

Fig. 4.—Photomicrograph of a section of a tonsil, showing lymphosarcomatous changes. Note the intact mucous membrane, and also the atypical lymphocytes to the right of the center of the section; × 150.

Lymphosarcoma, formerly included with pseudoleukemia, secured an independent pathologic position chiefly through the studies of Kundrat.[10] Structurally, he described the tumor to be composed of lymphoid cells of variable size, lying in an atypical reticular tissue. He made no mention of the presence of eosinophils in the microscopic sections, as did Fedeli [9] in his case report. He distinguished this process from the true neoplasms on the ground that it was not a spontaneous growth of multiple origin, with extension by metastasis, but a

10. Kundrat, Hans: Ueber Lympho-Sarkomatosis, Wien. klin. Wchnschr. **6**:211 and 234, 1893.

regional disease of lymphoid tissue, which propagated itself through the lymph paths. He considered it one of the most malignant diseases, resisting attempts at extirpation. He believed that it was closely related to pseudoleukemia and granuloma malignum, from both of which he had observed the development of lymphosarcoma. The picture as described by Kundrat is now generally accepted, with some modifications, as depicting a specific group of cases that require separation from other lymphoid tumors.

The modern conception is that lymphosarcoma is distinguished from other forms of lymphoma by its local destructive capacity and by the formation of true metastasis in distant organs. It may arise in a chain of lymph nodes or in a local lymphatic structure such as the tonsil. A characteristic differential point from Hodgkin's disease is that in lymphosarcoma the patient does not appear gravely ill until just before death, while in the former disease the patient presents a grave appearance, such as lassitude and emaciation, for a long period prior to death. Other observers, notably Desjardins and Ford [11] at the Mayo Clinic, from an analysis of case histories, stated that the symptoms are similar, and that they are difficult of differentiation since they run a parallel course. Warthin [12] stated that the atypical cells found in the neoplasm may appear in the blood, suggesting leukemia. When such a picture is present, great difficulty is encountered at times in making a differential diagnosis by hematologic studies. Microscopic examination of the tissues is the only satisfactory method of differentiation.[13]

Metastasis was formerly believed to be exclusively by way of the lymphatics. In the light of modern autopsy observations, this statement must be questioned, since metastasis occurs in the kidneys, brain and other structures. This can be explained only on the basis of vascular transmission. This is contrary to the original observation of Kundrat [10] and others who pioneered in the study of this disease. Koschier [14] reported the regression of a lymphosarcoma of the tonsil after a specimen had been taken for biopsy, with a subsequent recurrence in the abdomen. An interesting case has been reported by

11. Desjardins, Arthur, and Ford, F. A.: Hodgkin's Disease and Lymphosarcoma: A Clinical and Statistical Study, Collected Papers of the Mayo Clinic, Philadelphia, W. B. Saunders Company, 1923, vol. 15, p. 1217.

12. Warthin, A. S.: The Neoplasm Theory of Leukemia, with a Report of a Case Supporting This View, Tr. A. Am. Physicians **19**:421, 1904.

13. Osler, William: The Principles and Practice of Medicine, ed. 10, New York, D. Appleton & Company, 1926, p. 762.

14. Koschier, H.: Zur Frage der relativen Gutartigkeit mancher Sarkome und Karzinome, Wien. klin. Wchnschr. **23**:618, 1910.

Longcope,[15] in which a complete disappearance of extensive lymphosarcomatous tumors was followed by the death of the patient from asthenia.

Tuberculosis seems to occupy a prominent position as an exciting agent from the cases reported.[16] Many observers have found the tubercle bacillus so closely related to the development of lymphosarcoma per se, or as an underlying pathologic process, that the close association cannot be ignored. On the other hand, others [1] believe that any infectious agent may serve as the exciting cause. Unfortunately, so few cases are seen by any one investigator that to be dogmatic is hardly within the realm of scientific medicine.

The diagnosis, as in any type of malignant lesion, to be worth while must be made early.[17] The earlier it is made, the better is the result, with proper treatment. The differential diagnosis is not as simple as it may seem. The history, the clinical aspect of the patient, the local appearance of the lesion in the tonsil and hematologic studies combined with a study of microscopic sections must all be correlated to attain a satisfactory diagnosis. Even then, its differentiation from chronic lymphoid leukemia, leukosarcoma and small round cell sarcoma is at times extremely difficult.

Following is a report of three cases of primary malignant conditions of the tonsils; the first two are lymphosarcoma, and the third, a carcinoma.

REPORT OF CASES

CASE 1.—*History.*—F. R., a white man, aged 33, married, was first seen by me at the ear, nose and throat clinic of the Stanford University Medical School, on April 30, 1928, with the chief complaint of continual pain in the left side of the throat and neck, accompanied by dysphagia and marked salivation. He reported at the clinic on the request of his attending physician.

The family history was irrelevant. The past history was unimportant except for the ordinary diseases of childhood. The patient said that he had not had a venereal infection.

On March 25, 1928, a tonsillectomy had been performed on the patient under local anesthesia, by Dr. Julian Waller of San Francisco. On April 28, a secondary tonsillectomy was performed for the return of the mass in the left tonsillar fossa, by the same surgeon. This was done under general anesthesia at the French hospital. Tissue was sent to Dr. Jean Oliver, then associate in pathology at the Stanford Medical School.

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15. Longcope, W. T.: Retrogression in a Case of Lymphosarcoma of the Intestines and Peritoneum, Bull. Ayer Clin. Lab., Pennsylvania Hosp. **6**:1, 1910.

16. Ricker, Gustav: Ueber die Beziehungen zwischen Lymphosarkom und Tuberculose, Arch. f. klin. Chir. **50**:573, 1895.

17. Barnhill, J. F.: The Nose, Throat and Ear, New York, D. Appleton & Company, 1928, p. 207.

Examination.—The patient opened the mouth with difficulty. A mass about the size of a large pecan was seen in the left tonsillar area. It appeared hyperplastic, was broken down and had a tendency to ulcerate. It bled readily with trauma. The cervical glands of the upper anterior chain were enlarged. Tissue was removed for examination.

Laboratory Findings.—The Wassermann reaction was negative. A blood count and urinalysis gave negative results.

Pathologic Observations.—The pathologic report of tissue examination made by Dr. Oliver was as follows: Sections of the mass of tissue that developed after tonsillectomy showed the tissue to be composed of a mass of large atypical lymphocytes supported by a delicate reticulum. The normal structure of the tonsil was

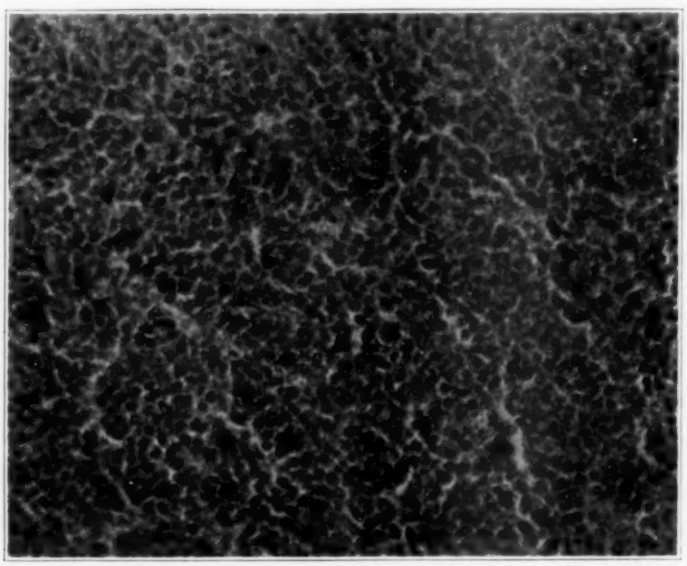

Fig. 5 (case 1).—Photomicrograph of a section of the lymphosarcoma of a tonsil. Note the large atypical lymphocytes throughout the stroma; × 240.

replaced by these cells, which had extended down and invaded the muscle. A small piece of mucous membrane was normal. On account of the atypical lymphoid cells, Dr. Oliver thought that the condition should be considered as lymphosarcoma of the tonsil.

Diagnosis.—The diagnosis was lymphosarcoma of the tonsil (fig. 5).

Treatment.—The patient was referred to Dr. Newell and Dr. Chamberlain of the roentgenologic department of the Stanford Medical School. He received varying doses of x-rays at weekly intervals between May 3 and June 14, inclusive. He then failed to report.

Follow-Up Record.—Information was obtained that the patient had visited a serum specialist, and that he had died some time during the fall, the exact date of which could not be determined.

Comment.—This was a definitely proved case of lymphosarcoma. Its pathology was early recognized by the attending physician. The patient received modern treatment by excellent roentgenologists. He discontinued what is probably the classic method of treatment for some unknown hypodermic medication in a nearby city. I think that had he been persistent in his treatment with the x-rays, his chances would have been good for at least a greater prolongation of life than he enjoyed.

Through the courtesy of Dr. Edward C. Sewall of the Stanford Medical School, I am able to report the following interesting case:

CASE 2.—*History.*—Mrs. M. J. B., aged 60, was first seen by Dr. Sewall with the following history: The family history was unimportant. The past history was irrelevant.

Three months previously, the patient had noticed a soreness of the right side of her throat, which commenced with a swelling in the region of the right tonsil. Two weeks prior to visiting Dr. Sewall, she noticed dysphagia and some difficulty in breathing.

Examination.—General physical examination gave negative results.

Otolaryngologic examination showed: The nose and ears were normal; in the mouth, there were numerous dental fillings and some oral sepsis; there was quite a large swelling in the throat, occupying the right tonsillar region and involving the soft palate for a distance of approximately 2 cm. in circumference. The throat was covered with large dilated veins; it seemed to have an ulcerated surface in the portion ordinarily occupied by the tonsillar crypts. This ulcerated area apparently split the tonsil into two parts. The uvula was not involved. The growth was very hard; there was no apparent cervical glandular involvement. The nasopharynx was apparently clear.

Laboratory Findings.—The Wassermann reaction was negative. Urinalysis gave negative results.

Clinical Diagnosis.—The diagnosis was malignant condition of the tonsil, type undetermined.

Advice.—It was advised that a specimen be taken for biopsy.

Pathologic Observations.—The pathologic report, made by Dr. William Ophüls of the Stanford Medical School, was as follows: Sections showed that the lymphoid tissue of the tonsil was almost entirely replaced by a tumor consisting of large round cells with large vesicular nuclei. A moderate number of mitotic figures were present. No giant cells were found. No eosinophils were present. On the surface, the tumor was ulcerated, necrotic and infiltrated with polymorphonuclear leukocytes.

Pathologic Diagnosis.—The diagnosis was lymphosarcoma of the tonsil (fig. 6).

Treatment.—The patient was referred to the x-ray department, where she received from Dr. Newell and Dr. Chamberlain one maximum roentgen dose of 1,300 erythema units to the area over the right side of the neck, the cheek and the tonsillar region.

Follow-Up Record.—The patient was seen at biweekly intervals by Dr. Sewall, Dr. Newell and Dr. Chamberlain. Two weeks after the original treatment, the tumor was greatly improved. One month after the initial treatment, the tumor had disappeared. The patient has been seen at varying times since her treatment. In answer to the last follow-up letter of Oct. 9, 1931, both the patient and the

attending physician stated that she was in excellent condition physically, and had at no time demonstrated any evidence of recurrence of her trouble, either locally or otherwise.

Comment.—This case is remarkable in that a definitely proved case of lymphosarcoma of the tonsil was followed by a five year recovery with no other treatment but one maximum dose of roentgen therapy. New [18] gave a complete statistical study from the Mayo Clinic of lymphosarcoma of the pharynx and tonsil. His report adds new light to the incidence of recovery from this pathologic lesion.

CASE 3.—*History.*—C. B., a white man, aged 56, married, was first seen by me at the request of Dr. A. L. Offield of Burlingame, Calif., on March 9, 1929, with

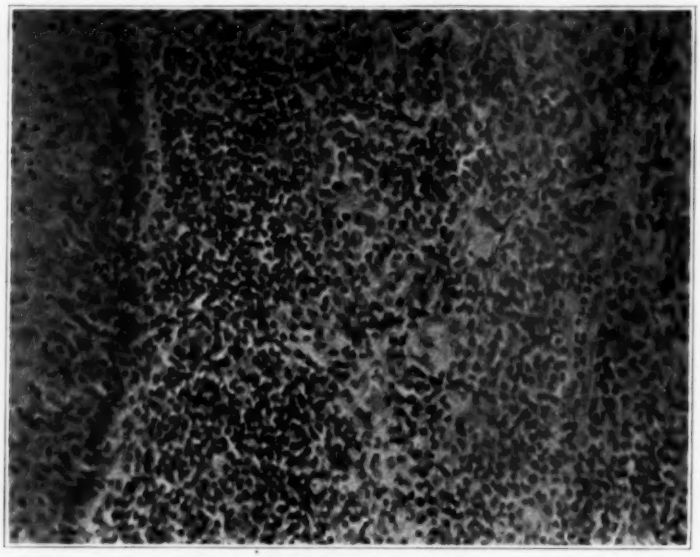

Fig. 6 (case 2).—Photomicrograph of a section of the lymphosarcoma of the tonsil. Note the mucous membrane beneath which can be seen normal lymphocytes. In the center and lower half of the field can be seen many large atypical lymphocytes; × 250.

the chief complaint of pain in the right side of the throat, dysphagia and marked salivation.

The family history was irrelevant.

The patient had had the ordinary diseases of childhood. He had had an initial lesion many years previously. Two years prior to consulting Dr. Offield, a small lump developed in the right submaxillary region. This continued to grow for six months. His attending physician in a nearby city opened the mass and drained it, according to the history. Several months later, the mass was again opened and drained.

18. New, Gordon: Tumors of the Pharynx and Tonsil, Proc. Staff Meet., Mayo Clin. **6**:654, 1931.

In December, 1928, two years after the original disturbance in the right submaxillary gland, the right tonsil became enlarged. At first it was painful, but the pain soon disappeared. The mass in the throat continued to enlarge. In March, 1929, that is, three months after the patient had noticed the tonsillar swelling, he entered the San Mateo Community Hospital. I saw him at this institution at the request of Dr. Offield.

Examination.—The patient opened his mouth with difficulty; a mass about the size of a walnut was seen in the right tonsillar region, which was fungating in character and extended backward toward the nasopharynx. It was ulcerated and bled easily. The upper right anterior cervical chain of glands was enlarged; a fistula was present in the region of the right submaxillary gland. General physical examination showed a definite tachycardia and a systolic murmur at the mitral

Fig. 7 (case 3).—Photomicrograph of a section of the tonsil, showing carcinomatous changes. Note the infiltration of epithelial cells. Mitotic figures can be readily seen; × 125.

region. An electrocardiogram, as interpreted by Dr. Gordon Hein of San Francisco, was thought to show arteriosclerotic changes.

Laboratory Report.—The Wassermann reaction was negative. A blood count and urinalysis gave negative results.

Pathologic Observations.—The pathologic report made by Dr. Kirk Prindle of the Mills Memorial Hospital of San Mateo was that the tumor was an epidermoid carcinoma of the right tonsil (fig. 7).

Treatment.—He was referred to the University of California Medical School for roentgen and radium treatment. After two visits to that institution, he discontinued the treatment and visited the cancer clinic at the Southern Pacific Hospital. I last saw him in June, 1929. The appearance of the lesion was one of slight improvement.

Follow-Up Record.—The patient died on Nov. 4, 1930.

Comment.—The interesting features in this case were the presence of the submaxillary fistula and the history of involvement of the gland for two years prior to the taking of the specimen for biopsy. It is unthinkable that the malignant disturbance could have been present for that long a time. I am compelled to believe that the patient had a septic process of some kind which necessitated the opening of the gland. The fact that he lived for nearly two years after the true diagnosis was made, with but two treatments of x-rays and radium, then going on with treatment with serum, leads one to believe that the lesion was of a very low grade of malignancy or that his treatment proved to be of some benefit.

TREATMENT

The treatment depends on the stage of the disease and the individual experience of the laryngologist. Christoforidis [19] contended that the x-rays and radium are at all times preferable to any other type of therapy. In this Dunn [20] agreed, and he expressed the belief that the treatment for primary malignant conditions of the tonsil of all types, including lymphosarcoma, resolves itself into massive exposure to the roentgen rays. In cases in which such treatment reduces the tonsil to nearly normal size, surgical intervention can be used as an adjunct; I advise against the cold steel knife and that the cautery be used instead. At all times the patient should be under the close observation of the roentgenologist. Skinner's [21] experience led him to believe that radium, in addition to the x-rays, has proved of value in the treatment for malignant disease of the tonsil. Harmon Smith [22] has used the cautery with success. Robinson [23] reported a series of cases in which the patients were treated with interstitial radium implants into primary sarcomatous growth of the tonsil, including lymphosarcoma. He obtained no clinical cures in cases of palpable cervical metastasis. Yates [24] stated that radium and the roentgen rays can destroy primary lesions, but too often they fail to control them. His contention is that

19. Christoforidis, M.: Ueber Tonsillartumoren und deren Behandlung mit Roentgenstrahlen, Ztschr. f. Hals-, Nasen- u. Ohrenh. **22**:554, 1929.

20. Dunn, L. S.: Tumors, Benign and Malignant, of the Tonsil and Peritonsillar Area, Laryngoscope **39**:16, 1929.

21. Skinner, E. H.: Lymphosarcomata and Other Glandular Enlargements of the Neck: Their Radiation Treatment, J. Missouri M. A. **20**:377, 1923.

22. Smith, Harmon: Lymphosarcoma, New York M. J. **99**:779, 1914.

23. Robinson, G. A.: Radium in the Treatment of Tumors of the Tonsil, Am. J. Roentgenol. **23**:643, 1930.

24. Yates, J. L.: The Proper Treatment of Chronic Malign Diseases of the Superficial Lymph Glands, Arch. Surg. **5**:65 (July) 1922.

too little use is made of the actual cautery. Sir William Milligan [25] described his method of treatment, which is a combination of surgical diathermy and radium. This treatment is applicable to malignant disease of the tonsil, pharynx and posterior third of the tongue. From a visit to many clinics both in this country and abroad, as well as in discussing this problem with men of great clinical experience, I am inclined to believe that this method is rapidly gaining favor.

25. Milligan, William: Radio-Diathermy in the Treatment of Inoperable Malignant Disease of the Upper Air and Food Passages, Brit. M. J. **1**:364 (Feb. 27) 1926.

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ODONTOMA OF THE MAXILLARY SINUS

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An odontoma is a tumor of dental origin, a tumor of the teeth. The term was first coined by Broca [1] in 1869. Since that time a great deal of confusion has arisen in regard to the classification of "odontomas."

The definitions of odontoma given by Bland-Sutton,[2] Dennis, Hopewell-Smith [3] and others are not sufficiently restricted. The word odontoma permits the inclusion of all new growths arising from the dental system whether they are hard or soft. Perthes [4] gave a very brief classification. He divided these tumors into two groups, namely, simple odontomas, comprising the free and adherent varieties, and composite odontomas. In contradistinction to this classification is the one given by a special committee of the British Dental Association in 1914, and contained in the publication, "Report on Odontomes." [5] Their classification is a lengthy one and includes all possible forms of these tumors.

Without going into the details of the more complicated classifications of the various authors, I propose to give a brief definition that will apply to the actual tumor in question. An odontoma is a tumor composed entirely of tooth tissue; it may be enamel, cement or dentin. Two or more of these tissues may be included in the same tumor.

The type of tumor under discussion is a "composite odontoma," because it is composed of the different structures that enter into the formation of a tooth. Many tooth germs have united so as to form an irregular mass, which bears but little resemblance to a normal human tooth. In about two thirds of such cases, the tumor is situated in the ramus of the jaw, and in the other third, in the maxilla. These lesions may invade the antrum and produce deformity of the face.

Submitted for publication, Dec. 19, 1931.

From the Departments of Otolaryngology and Pathology, Montreal General Hospital.

1. Broca, P.: Traité des tumeurs, Paris, P. Asselin, 1869, vol. 2, p. 275.

2. Bland-Sutton, J.: Odontomes, Tr. Odont. Soc. Great Britain **20**:32, 1887-1888.

3. Hopewell-Smith, Arthur: Normal and Pathological Histology of the Mouth, Philadelphia, P. Blakiston's Son & Co., 1918, vol. 2, p. 206.

4. Perthes, G.: Die Verletzungen und Krankheiten der Kiefer, Stuttgart, 1917.

5. Gabell, James and Payne: Report on Odontomes, Tr. Brit. Dent. A., 1914.

REPORT OF A CASE

History.—On Jan. 10, 1930, R. N., a French Canadian, aged 23, was referred from the dental clinic in the Montreal General Hospital to the nose and throat department because of a swelling on the right side of the face.

Present Illness.—About three months previous to his admission, the patient had had one of his right upper molars extracted on account of toothache. Soon after this he had severe pain and swelling in this region. He was told that he had an abscess in the gums. The right cheek and eye were swollen considerably. On May 15, he went to the dental clinic, where the abscess was incised and pus evacuated. The swelling and pain were lessened, but a hard lump remained in that area, and the toothache persisted. The right cheek was swollen but not painful. When the upper lip on the right side was lifted up, an exposed area of bone (1.5 cm. in diameter) was seen, in the region of the right alveolar ridge at its posterior extremity, just above the area where the right upper molars are normally located. The surface of this bony mass was irregular and covered with wartlike excre-

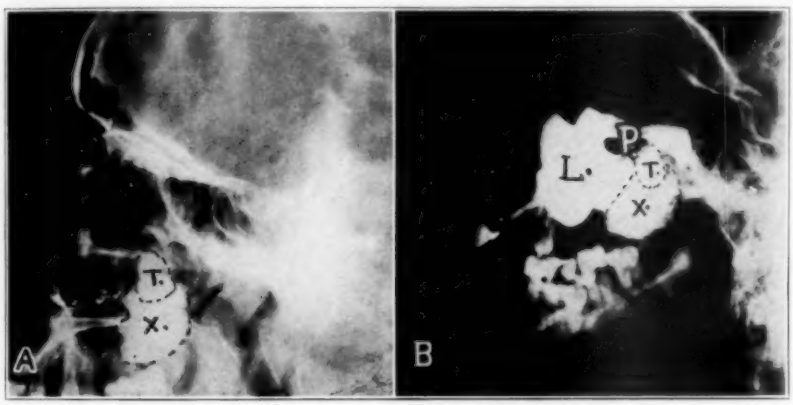

Fig. 1.—*A*, lateral roentgenogram of the skull. *X.*, tumor; *T.*, molar tooth situated on top of the tumor (the tumor and tooth are outlined with a stippled line.) *B*, lateral view, following injection of iodized oil into the right antrum. *X.*, tumor; *T.*, tooth; *P.*, polyp; *L.*, iodized oil.

scences. There was a sinus leading into this mass, posterior to the first bicuspid tooth. This sinus was exuding pus.

Rhinoscopic examination revealed pus in the right meatus, below the inferior turbinate. There was no encroachment on the nose by the mass. All the teeth posterior to the first bicuspid were absent on this side.

Roentgenograms (fig. 1) revealed a dense shadow occupying the posterior part of the right antrum, extending down below the palatal process of the right maxillary bone and obliterating a part of it. At the upper pole of this shadow, one could distinguish the outlines of a molar tooth (fig. 1 *B*, *T*).

Figure 1 *B* is a roentgenogram made after the right antrum was filled with iodized poppy seed oil 40 per cent. It was interesting because it demonstrated a black shadow (*P.*) in the antrum (an area into which the iodized oil did not penetrate) which was probably a polyp; the outline of the tooth was also thrown into clearer relief.

Operation.—On June 19, the usual incision for the Caldwell-Luc operation was made. On elevation of the mucoperiosteum an irregular, hard, bony surface was exposed. This bony mass extended upward toward the outer angle of the orbit. The facial wall of the antrum was then broken through. Between this mass and the infra-orbital foramen, the entire antral cavity was encroached on by this irregular tumor. What was left of the antral cavity, above and medially, was filled with polypi (fig. 2). When the polypi were removed and the mucous membrane lining the narrowed cavity was stripped, a root of a tooth, covered with mucous membrane, was stretched across the antral cavity, its apex abutting against the nasal wall. The crown of the tooth was fixed into the aforementioned bony mass. The bony tumor was solidly incorporated with the bony facial wall and the palatal process of the maxilla. To pry it loose from its moorings, it was chiseled into from above, behind and below. With a pair of rongeurs, the main portion of the tumor was rocked out of its bed. This left a large excavation in the region

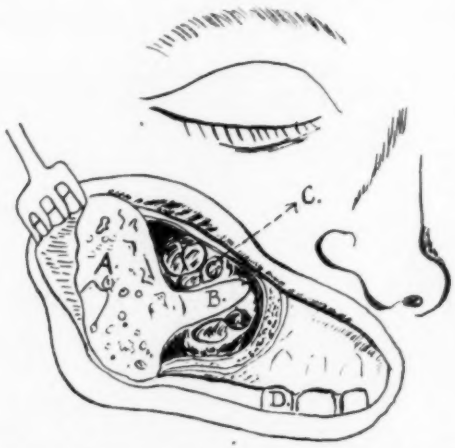

Fig. 2.—Appearance at operation after the tumor was exposed and the antrum opened. *A.*, appearance of tumor; *B.*, root of molar tooth lying across the antral cavity; *C.*, polypi in antrum; *D.*, normal first bicuspid tooth.

normally occupied by the antral cavity. When the main mass was delivered from the antrum, a fully developed molar tooth was seen lying loose in the antral cavity.

The antrum was curetted, and the polypi and the hypertrophied mucous membrane that filled the spaces not occupied by the bony tumor were removed. A large counter-opening was made in the nose below the inferior turbinate. The large gaping deficiency at the outer angle of the wound, where the tuberosity and the outer alveolar margin of the maxilla had been absorbed by the tumor, was closed by a plastic flap turned down from the inner side of the cheek. The edges of the wound were tightly drawn together. A gauze drain was inserted through the nose into the antral cavity.

The patient made an uneventful recovery except for a fistula at the outer angle of the wound, which required two subsequent minor operations to close, one on September 27 and another a month later.

Description of the Tumor.—The tumor, as already noted, came away in two pieces, the larger mass being the tumor proper, and the smaller part the detached molar. When put together, the tumor measured 4 by 3 cm. The outer surface was

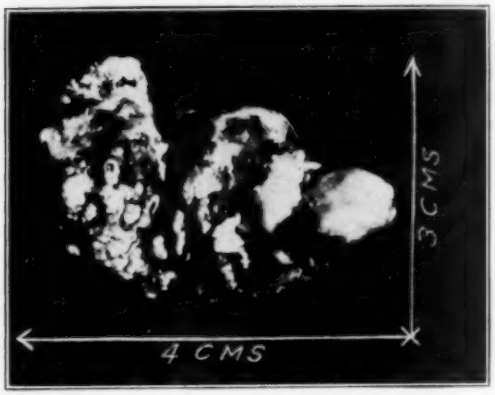

Fig. 3.—Photograph of tumor after its removal.

Fig. 4.—Tumor divided into two parts along its longitudinal axis. *R.*, area around which a cluster of teeth are arranged in rosette fashion. *M*, longitudinally cut molar (slightly enlarged).

rough, irregular, bony, hard and studded with numerous (over 100) white glistening pearly elevations, measuring from 2 to 6 mm. When these elevations were examined by means of a magnifying lens, one could identify them as miniature incisors, canines and molars. The whole growth appeared as if one had taken a handful of diminutive teeth, thrown them into a mass of plaster of paris and allowed the plaster to set (fig. 3).

To give one an idea of the hardness of the tumor, it might be mentioned that in order to investigate its appearance in cross-section, I tried to cut the tumor in two by means of a jeweler's fret-saw. In one-half hour's labor, a depth of 2 mm. was penetrated. The specimen was then taken to the Pathological Department of McGill University, and to the unsuspecting technician was entrusted the task of

Fig. 5.—Figure 4 magnified slightly. Note the canals and various pulp-cavities cut across longitudinally, horizontally and tangentially. *M.*, molar.

dividing the specimen into two sections by means of his motor-driven 16 foot band-saw. Sparks flew, and the specimen was divided, but the teeth of the band-saw were worn down!

When the cut surface was polished, it became as smooth and as glistening as a polished piece of ivory (fig. 4). The surface was studded with miniature teeth, cut in all planes, longitudinally, tangentially and horizontally. By means of a lens, one could see root-canals, enamel, dentine, pulp-cavities, etc.

DIAGNOSIS

The diagnosis of "odontoma" is not particularly difficult if a careful study is made of the case. A good history of the case is essential.

In the case described there was a definite history of difficult and painful dentition during infancy and childhood. A careful rhinologic examination of the nose and accessory sinuses should be made to exclude other more common conditions. Clearly defined roentgenograms, perhaps aided by injections of iodized oil, will often settle the diagnosis.

Dentigerous cysts are slow-growing and painless, and when they reach a considerable size encroach on the nasal cavity, palate or orbit. The shadows that they cast on roentgenograms are round and smooth, with definite outline; they are radiolucent because of the fluid in the tumors.

The surface of bone is spongy, while the odontoma is dense. Osteosarcoma shows signs of malignancy soon after the beginning of its growth, and the tissues break down.

In their early development bone cysts may be mistaken for dentigerous cysts or odontomas. As they increase in size, their walls may easily be penetrated and the fluid contents evacuated, while odontomas remain solid.

CONCLUSIONS

A large odontoma of the maxillary antrum is comparatively rare. The majority of odontomas are small; the larger ones usually invade the lower jaw.

The diagnosis, as already stated, is not difficult. In the present case, however, the clinical diagnosis was somewhat obscured by the fact that there was a sinus over the exposed surface of the tumor, suggesting the possibility of malignancy.

The treatment is surgical removal intra-orally. The case described was complicated by the presence of a chronic antral suppuration with polypi formation. The large gaping wound in the maxilla, caused by the removal of the tumor, necessitated two subsequent minor plastic operations to close the fistula leading into the antrum at the outer angle of the wound.

NATURAL ORIFICE OF THE MAXILLARY SINUS

II. CLINICAL STUDIES

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Irrigation of the maxillary sinus is frequently carried out because of its value as a diagnostic and therapeutic method in the management of disease in this cavity.

The maxillary sinus was first described by Julius Casserius [1] in 1612. Andre Vesalius called attention to the space in the upper jaw in 1643, and Jeanty [2] mentioned that this structure was known to Fallopius in 1584 and to Ingrassius in 1603. In 1651, Nathaniel Highmore described a case of suppurative disease of the maxillary sinus. Since that time it has been known as the antrum of Highmore.

Irrigation can be carried out by means of any technic or operation that provides access to the antral cavity. There are five methods for accomplishing this:

1. Irrigation through the alveolar margin after a tooth, usually the first molar, has been extracted (Meibomius,[3] 1718 and Drake,[4] 1722). This method is not used in rhinologic practice today unless an infected root, which is the cause of antral disease, has been extracted and has left a temporary communication with the antrum.

2. Puncture through the inferior meatal wall by means of a needle (Lichtwitz, 1886) or trocar (Krause,[5] 1887) or a styletted instrument (Mikulicz,[6] 1886).

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From the Departments of Laryngology, Mount Sinai Hospital and Kings County Hospital.

1. Casserius, J.: Nova anatomia, Frankfurt, 1612.

2. Jeanty, J. Marcel: De l'empyème latent de l'antra d'Highmore, Bordeaux, 1891.

3. Meibomius, H.: De abscessuum interiorum natura et constitutione, Dresden, J. J. Wincklero vid., 1718, p. 113.

4. Drake: Traitement des abcès du sinus, 1722; quoted by Jeanty (footnote 2).

5. Krause: Instrumente nach Dr. Krause, Monatschr. f. Ohrenh. **21**:70, 1887.

6. Mikulicz, J.: Zur operativen Behandlung des Empyems der Highmorshöhle, Ztschr. f. Ohrenh. **7**:257 (July 31) 1886.

3. Puncture through the middle meatus by means of a sharp needle or trocar—first suggested by Zuckerkandl [7] and first performed by Hartmann,[8] 1884.

4. Puncture through the anterior wall in the canine fossa (Lamorier,[9] 1743).

5. Irrigation without puncture through the ostium of the maxillary sinus or through its accessory ostium when such a structure exists.

The first attempt to treat disease of the maxillary sinus by approaching it through its ostium is credited to Jourdain,[10] a dentist of Bordeaux, who practiced his method for some time on the cadaver before using it on the living. In 1765, he passed a cannula through what he thought was the normal ostium. Prior to that time one or more teeth were being extracted according to the teachings of Meibomius and Drake, or puncture of the face of the maxilla was done according to Lamorier's method.

Claim was made by the sons of Allouel (quoted by Courtade [11]) that their father had success in treating the maxillary sinus by means of irrigating through its ostium. The elder Allouel had thought of this technic in 1737 and practiced it two years later. Jourdain was enthusiastic about his method and published several papers on it. As a result of his claims, a commission of French surgeons investigated his procedure and submitted a report, which, in the main, condemned it.

Jourdain's description of his first experience and the report of the commission are given in full because of their historical value and interest.

He decided to try the natural passages because of his difficulty in getting through the alveolar process and because he wanted to spare his patient as much pain as possible. The report of his experience follows:

> The patient being placed upon a lounge with the head thrown back, I first with a solid sound or stylet ascertained the exact position of the opening. I then took a hollow sound about the size of those used for the nasal canal, but two inches longer and more curved at the extremity entering the nostril. This I introduced

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7. Zuckerkandl, E.: Normale und pathologische Anatomie der Nasenhöhle, Leipzig, Wilhelm Braumüller, 1893.

8. Hartmann, A.: Ueber Empyem der Oberkieferhöhle, Deutsche med. Wchnschr. **15**:190 (March 7) 1889.

9. Lamorier, quoted by Jeanty (footnote 2).

10. Jourdain: A Treatise on Diseases and Surgical Operations of the Mouth and Parts Adjacent, translated from the last French edition, Philadelphia, Lindsay & Blakiston, 1851; Recherches sur les différents moyens de traiter les maladies du sinus maxillaire, J. de méd. de Paris **27**:52, 1767.

11. Courtade, A.: Étude historique sur l'empyème du sinus maxillaire, Ann. d. mal. de l'oreille, du larynx **19**:497 (June) 1893.

into the right nostril carrying its point under the middle turbinated bone. About two lines before this toward the inferior turbinate bone, I encountered a duplication of mucous membrane; raising the point of my instrument to avoid this, I came upon the opening of the sinus which by using some force I penetrated. I then passed through the sound some barley water injection and dismissed the patient the sound still remaining till the next day. Then I repeated the injection, removed the sound and requested the patient to blow her nose, by which she discharged a greenish and highly offensive mucus. I now repeated my injections and as the outlet was free did not allow the sound to remain. This treatment continued for about six weeks and resulted in a cure.

As a result of its inspection of Jourdain's technic, the commission rendered the following report:

The commission found that most often the wall of the sinus was very fine and purely membranous between the two turbinates. The sound carried through the nostrils pierces it and falls into the sinus with great ease. This happened in two sinuses out of ten in five subjects. It follows that it is possible to sound the sinus through its natural ostium. It can also often happen that the sound may be introduced through an opening made accidentally between the middle and inferior tur-

Fig. 1.—Cannula of Jourdain.

binates. This artificial opening cannot be made without serious danger; it can often pass for entrance by way of the ostium of the sinus, and this consideration alone suffices to establish the fact that this operation is as difficult as it is uncertain.

There is no doubt that Jourdain forced his cannula through the nasal wall. Both the shape of the cannula as it is illustrated in his book and the fact that the patient wore it undisturbed for twenty-four hours are strongly in favor of this assumption. As a result of the adverse report of the commission, the medical profession relied principally on the extraction of teeth and trephining of the anterior wall of the maxilla for purposes of irrigation.

Many statements have been made by rhinologists of repute regarding the practicability and the expediency of this method. These statements have been found to be highly contradictory. A study of the literature reveals that only a few of those who have condemned this method have demonstrated a knowledge of the anatomy involved. In some instances the inference can be drawn that the method was not given a fair clinical trial before it was condemned. During the latter part of the nineteenth century, treatment of the antrum through its ostium was advocated by several rhinologists.

Stoerk [12] preferred the natural orifice passage to the newly introduced puncture of the inferior meatus by Lichtwitz. Jelenffy [13] wrote a series of articles advocating this technic. Hansberg [14] was enthusiastically in favor of this procedure and claimed that two thirds of all maxillary sinuses could be entered in this way.

In 1882, Hartmann [8] advocated irrigation through the maxillary ostium. By this method he was able to irrigate 23 of 32 maxillary sinuses. He also advocated enlarging the region of the ostium with the cautery if necessary.

Some years later Garel [15] cited the divergence of opinion concerning this procedure. He was strongly in its favor. He said: "Objections have some grounds but only in the exceptional cases." He was able to irrigate 32 of 44 maxillary sinuses with the catheter of Heryng. In 1902, J. A. Thompson [16] spoke in favor of the natural orifice approach. Norval H. Pierce [17] and Yankauer [18] have been strong advocates of this method for many years. Their cannulas are widely used. Arrowsmith [19] has used a natural orifice cannula for many years and has always preferred it to the puncture needle or trocar. In 1914, Kosokabe [20] investigated 484 maxillary sinuses through their natural orifices, 68 of which proved to be positive for suppurative disease. He does not state his percentage of successes or failures, so that one must infer that he entered all the sinuses with this cannula. If that is so, he is confounding passage through the ostium with passage through the lateral wall in the region of the middle meatus. Yankauer [18] and Goldman recently reported a small series of experiences with irrigation of the antrum in infants and young children.

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12. Stoerk: Ueber die lokale Behandlung des Empyems der Highmorshöhle, Wien. med. Wchnschr. **36**:1433 (Oct. 23) 1886.

13. Jelenffy: Ueber Ausspülung der Oberkieferhöhle, nebst einer Antwort an Dr. Broich, Berl. klin. Wchnschr. **26**:234 (March 18) 1889; Zur Frage Ausspülung der Highmorshöhle, ibid. **26**:777 (Sept. 2) 1889.

14. Hansberg: Die Sondierung der Nebenhöhle der Nase, Monatschr. f. Ohrenh. **24**:3 (Jan.) 1890.

15. Garel, J.: Diagnosis and Treatment of Suppuration of the Maxillary Sinus, J. Laryng. & Otol. **8**:528 (Aug.) 1894.

16. Thompson, J. A.: Acute Suppuration of the Maxillary Antrum Treated Through the Natural Opening, Cincinnati Lancet-Clinic **48**:275 (March 8) 1902.

17. Pierce, Norval H.: Treatment of Antrum of Highmore Through the Natural Opening, Laryngoscope **11**:197 (Sept.) 1901.

18. Yankauer, S., and Goldman, I.: Lavage of the Maxillary Sinus Through the Natural Orifice in Infants, Arch. Otolaryng. **8**:187 (Aug.) 1928.

19. Arrowsmith, H.: Personal communication.

20. Kosokabe, H.: Ueber die klinische anatomische Untersuchung des Ostium maxillaire, Arch. f. Laryng. u. Rhin. **29**:155, 1914.

There have been objectors to this technic ever since the adverse report of the commission of French surgeons in 1769. This report was referred to by Giraldès [21] almost a century later, in 1856. Jeanty (1891) recognized the simplicity of the method and the lack of pain in natural orifice

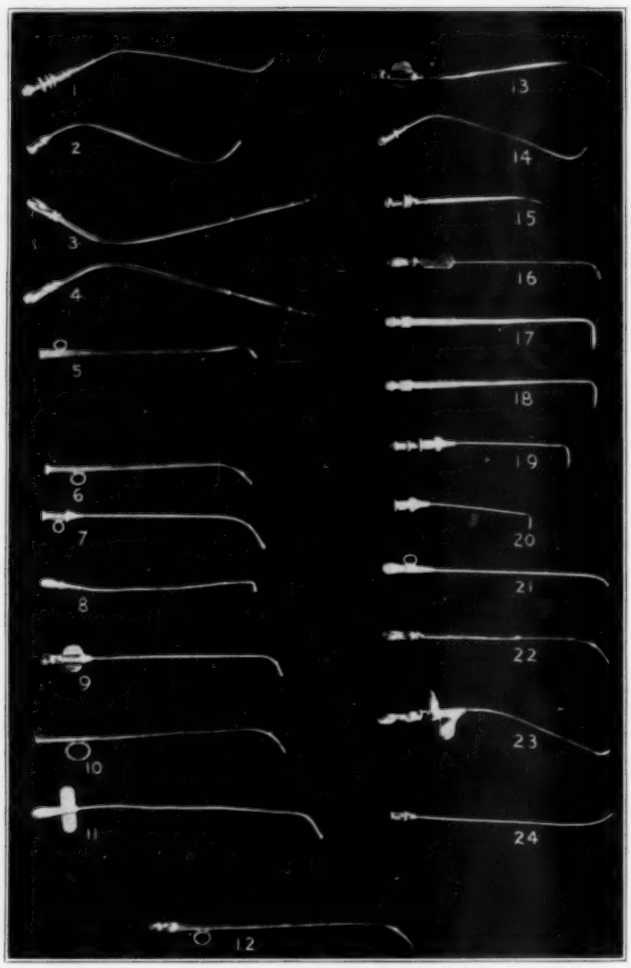

Fig. 2.—Photograph of various natural orifice cannulas in use today: *1,* Pierce's; *2,* Hajek's; *3* and *4,* Mullin's; *5,* Haskin's; *6,* Siebenmann's; *7,* Friedberg's; *8,* Health's; *9,* Beck's; *10,* King's; *11,* Lillie's; *12,* Bowers', *13,* Perlman's; *14,* Shea's; *15,* Mackenty's; *16,* Fenton's; *17,* Yankauer's for large adult; *18,* for small adult; *19,* for large child; *20,* for small child; *21,* Vernon's; *22,* Goodfellow's; *23,* Gill's, and *24,* Craig's.

21. Giraldès, J. A.: Des maladies du sinus maxillaire, Thèse, Paris, 1851; Ueber die Schleim Cysten der Oberkieferhöhle, Virchows Arch. f. path. Anat. **9**:463, 1856.

catheterization, but felt that the technic represented a perforation rather than a true sounding of the ostium. Many have objected to this method on the ground that the maxillary ostium is located in an inaccessible position in the depth of the infundibulum. Some contend that the middle turbinate is in the way of successful sounding. Others have claimed that the cannula perforates the membranous portion of the middle meatus when the operator believes that the instrument is in the ostium. Skillern [22] does not think that this method is practical. Schaeffer,[23] on a basis of his anatomic studies, expressed the belief that "it is impossible clinically in a vast majority of cases to sound the maxillary sinus through its normal ostium."

Sieur and Jacob [24] stated that since the ostium opens into the lowermost portion of the infundibulum, one must agree with Zuckerkandl that "it is entirely superfluous to tire oneself in sounding it."

I was impressed with the fact that none of those who objected to the technic had undertaken to establish by actual clinical application, the percentage of maxillary sinuses that one could enter. Most statements for and against appear to be based on inference or conjecture but not on careful clinical trial. The exception is Chiari,[25] who is quoted as stating that in only 1 of 28 cases was he able to wash pus out of an antrum through the maxillary orifice. It is not stated how many of the 28 sinuses were proved to have pus, however.

It was therefore thought that a clinical study that would establish the proportion of successes and failures in the passage of a cannula through the maxillary ostium should be undertaken.

CLINICAL PROCEDURE

The successful passage of a cannula into the ostium of the maxillary sinus requires a knowledge of the applied anatomy of the lateral nasal wall, especially in its anterior portion. This phase of the subject is dealt with in detail in another paper. It is sufficient to mention briefly the ethmoidal bulla, the uncinate and the infundibulum. The bulla ethmoid-

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22. Skillern, R. H.: Accessory Sinuses of the Nose, ed. 4, Philadelphia, J. B. Lippincott Company, 1923, pp. 112, 119 and 120.

I am informed that the late Dr. Skillern had changed his views concerning irrigation through the maxillary ostium.

23. Schaeffer, J. P.: The Nose—Paranasal Sinuses, Naso-Lacrimal Passageways, and Olfactory Organ in Man, Philadelphia, P. Blakiston's Son & Co., 1919, p. 127; The Sinus Maxillaris and Its Relations in Embryo Child and Man, Am. J. Anat. **10**:313, 1910.

24. Sieur and Jacob: Recherches anatomique, cliniques, et opératoires sur le fossa nasales et leurs sinus, Paris, J. Rueff, 1901, p. 543.

25. Chairi, O., abstr., New York State J. Med. **43**:302 (March 11) 1893.

alis and the uncinate process are separated from each other by a trough, cleft or groove which is known as the infundibulum. The maxillary ostium can usually be found in the most posterior portion of the infundibulum. All these structures are usually under cover of the anterior end of the middle turbinate.

The maxillary ostium occupies a vertical, horizontal or oblique position in the infundibulum. This variation in position is usually not mentioned in articles on this subject. In fact, I have been able to find but one author, Gosselin,[26] who mentioned the horizontal and vertical positions of the ostium. To these should be added the oblique position which is occasionally encountered. If the rhinologist will bear in mind the fact of this variation in position, he will more readily be able to catheterize the ostium. The most constant anatomic guide to the location of the ostium was found to be the angle formed by the divergence of the posterior curves of the bulla and the uncinate. This was seen to be the case in an anatomic study of 114 lateral nasal walls. When the ostium is so placed and is not occupying a greater part of the infundibulum, a cannula placed anywhere anterior to the ostium will pierce the os planum and penetrate the orbital cavity. Beyond the posterior angle just mentioned is the membranous portion of the middle meatus. It is in this membranous portion that the accessory ostium is to be found. No attempt was made to look for an accessory ostium in this study, although the accessory ostium is known to exist in from 10 to 50 per cent of lateral walls.

In order to pass a cannula into the maxillary ostium, anesthesia must be produced in the region through which the cannula must travel. Therefore a small tampon saturated with 10 per cent cocaine epinephrine solution is insinuated under the anterior end of the middle turbinate. If the middle turbinate is very close to the lateral wall it may be necessary to anesthetize the immediate preturbinal area before the tampon can be placed in the middle meatus. The tampon is made quite thin, and can in almost all cases be insinuated into the region of the infundibulum, especially in its posterior portion. After a few minutes the tampon is removed, and a cotton tipped fine applicator carrying the same solution is placed into the infundibular region. The applicator can be so bent as to be insinuated behind the uncinate thereby assuring a better anesthesia. When this area is rendered insensitive, the cannula can be introduced.

The instrument is held in the right hand for the right side, and in the left hand for the left side. The distal end of the cannula is brought under the anterior end of the middle turbinate, and is hooked over the uncinate. It is slowly moved backward toward the posterior end of the

26. Gosselin: Sur l'orifice du sinus maxillaire, Compt. rend. Soc. de biol. **3**:53, 1851.

infundibulum where the angle formed by the posterior end of the bulla and uncinate is to be found. The cannula is first directed so that the distal end is pointing vertically downward; in other words, as if one were trying to sound a horizontally or obliquely placed ostium. If such an ostium exists, the cannula will assume an inverted position. If the cannula does not fall into an ostium, the anterior and posterior borders of which will confine it, it is now directed laterally so as to attempt to enter a vertically placed ostium. If a vertical ostium exists and is within reach, the cannula will fall into it. One knows that his instrument is in the ostium by the depth of penetration of the instrument and by the excursion of the distal end of the cannula, which is controlled by the diameter of the ostium. The firmness of the bony anterior boundary is

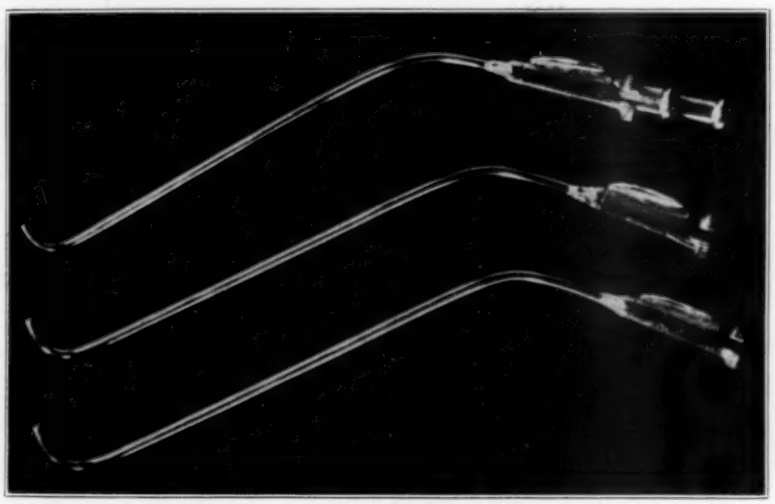

Fig. 3.—Author's cannula; three sizes.

unmistakable when the cannula is moved forward. Before I appreciated this point, I was irrigating an antrum with slight difficulty, that is, there was slight bruising and slight bleeding, when it was noted that this antrum had a horizontally placed ostium that could be readily entered with the cannula inverted and without causing bruising or bleeding. This case demonstrated that one could easily perforate the membranous portion of the middle meatus and not realize it if one did not pay particular attention to the placement of the cannula and to its relations with the brim of the ostium.

This study is based on an attempt to irrigate 170 maxillary sinuses consecutively. The ages of the patients ranged from 5 to 64 years. The Pierce cannula and my modification of this instrument were used. The purpose of the study was to ascertain the frequency with which one

could irrigate a diseased antrum through its ostium, and to record such factors as might be of value in interpreting successes and failures.

By success is meant the passage of the cannula into the ostium with a minimum of trauma and discomfort to the patient. The rule should be that no bleeding should occur after the cannula is withdrawn. Perfora-

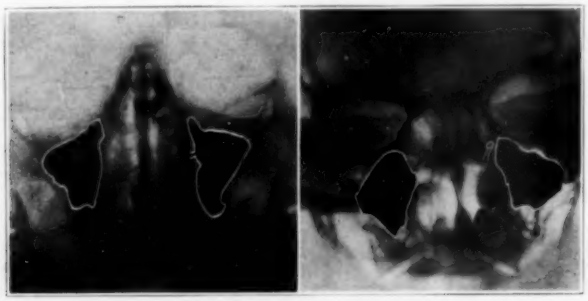

Fig. 4.—Studies made in iodized poppy-seed oil 40 per cent showing a vertically placed ostia. One film illustrates the ostium with iodized oil dropping through it into the nose. (Collection of Dr. Rubin.)

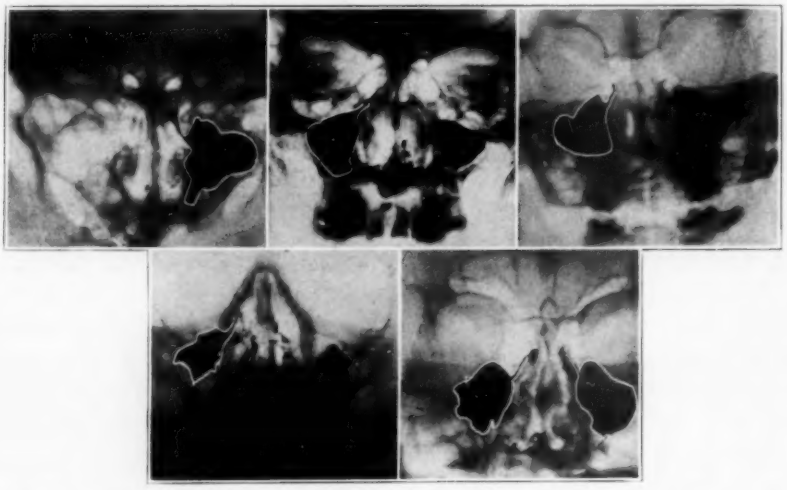

Fig. 5.—Studies made with iodized oil showing horizontal and oblique nasomaxillary passageways. (Collection of Dr. Rubin.)

tion of the membranous portion invariably causes some bleeding. Although never copious, it is always more than a mere streak and sometimes comes out of the nose in drops in rapid succession. The passage of the cannula into the maxillary ostium was successful in 138 instances, or 81 per cent, and unsuccessful in 32, or 19 per cent.

The direction of each ostium was noted. Thirty-four were horizontally placed, 6 were obliquely placed and 98 were vertically placed.

It was found that the same patient could have a horizontal ostium on one side and a vertical one on the other.

Recently, Dr. Marvin Jones called my attention to the fact that he had noticed a nasomaxillary passageway in some of his films made following the injection of iodized poppy-seed oil 40 per cent. With this in mind, I reviewed the collection of Dr. Herman Rubin and found several

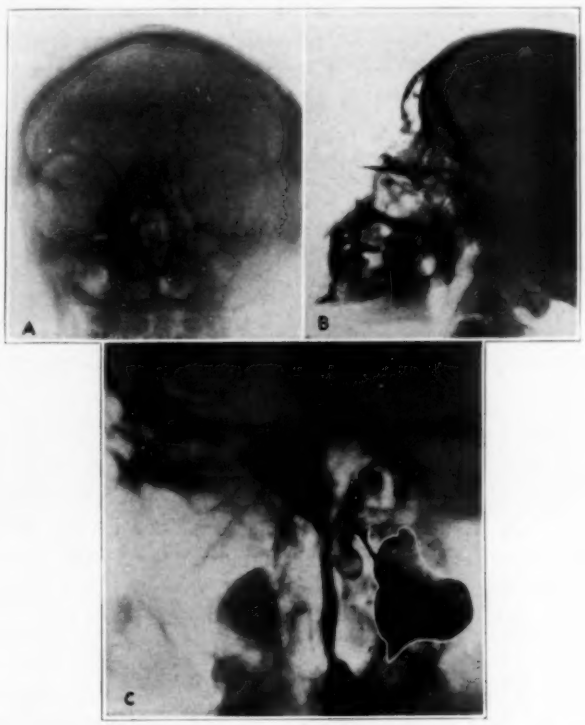

Fig. 6.—Roentgenograms (*A* and *B*) showing the cannula in an oblique passageway. *C* is a study made following injection of iodized oil in the same antrum, illustrating the oblique passageway.

such passageways which are outlined in the accompanying illustrations. Figure 6 shows a cannula obliquely placed in the nasomaxillary passage and a study of the same antrum after the injection of iodized oil confirms the oblique direction of this structure (my case, figs. 4 and 5).

How can one tell that the cannula is in the antrum? The depth of the position of the distal end of the cannula is of value. When this end is well out of sight and the proximal end of the instrument is close to the septum or up against the anterior border of the ala nasi, the cannula is

usually in place. The facts that pus or mucopus is washed out with the return fluid and that the patient feels the fluid in his antrum, especially when the pressure is suddenly increased, are of value. The type of sound that one hears when air is introduced into the antrum after the irrigation is distinctive. This has been characterized by Lermoyez [27] as hydro-aerique. All the foregoing facts are evidence of the proper placement of the tube.

CLINICAL OBSERVATIONS

The following observations are of interest:

The Middle Turbinate.—The middle turbinate was found so tightly placed against the lateral wall that the middle meatus could not be reached in a single case of this series. In 3 cases the septum was so badly deviated that the middle turbinate could not be visualized.

Bulla Ethmoidalis.—The bulla did not appear to be a hindrance to the passage of the cannula in any case. In 2 cases in which the bulla was unusually prominent, the ostium was readily entered after cocainization. It must be remembered that the bulla tapers away from the uncinate and that the infundibulum becomes wider in its posterior part.

Uncinate Process.—The uncinate was regarded as high or prominent in many instances in which the cannula was readily passed into the ostium; therefore, the height of the uncinate does not always govern one's success or failure in passing the cannula. A deep infundibulum that goes with a high uncinate might have an ostium vertically placed in its lateral wall which has a large supero-inferior diameter. The catheterization of such an ostium would not therefore be influenced by the high uncinate fence, for in several instances the upper border of the ostium reached above the upper border of the uncinate as was demonstrated in the studies on the cadaver. Such no doubt is frequently the case in clinical practice.

In most of the failures the infundibulum was readily entered, but the orifice could not be found. This may have been because I was dealing with an abnormally deep infundibulum where the ostium was out of reach.

Bleeding.—It was noted before this study was undertaken that the nasal wall in some cases was bruised during cocainization or instrumentation. Such trauma has been eliminated through a better understanding of the anatomy involved and a greater attention to the cocainization. When bleeding occurred as a result of penetrating the pars membranacea, it lasted from four hours to four days. The latter time is an exception.

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27. Lermoyez, M.: Thérapeutique des maladies des fosses nasales, des sinus de la face et du pharynx nasal, Paris, O. Doin, 1896, p. 105.

Occlusion of the Ostium by the Cannula.—Such occlusion was not observed in this study. It was noted that when the inflammation was subacute and the discharge was thick and of a mucopurulent type, the fluid appeared to be trapped in the antrum temporarily. It seemed that the fluid could not leave the antrum as quickly as it was entering, so that positive pressure was generated in the sinus cavity. This caused pain in the region of the cheek. In such cases the irrigating fluid was successfully returned. Acutely involved antrums were not irrigated. Occasionally one encounters a subacutely involved antrum, the nasal wall of which is quite tender. In such cases the cocainization may take a little longer to effect.

The cannula is so easily introduced in a majority of the ostia that are catheterized that this method becomes a most desirable procedure. Dropping the cannula into a hole, when it is easily done, cannot be compared to puncturing a bony wall, however thin.

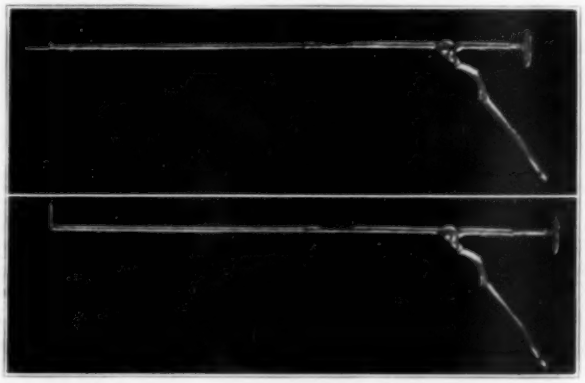

Fig. 7.—Calibrator used for measuring the anteroposterior diameter of vertical ostia.

Relation of the Ostium to the Middle Turbinate.—A great majority of the ostia were found to be located behind the anterior end of the middle turbinate. In eighteen instances it was found that the anterior border of the ostium was on a line with the anterior edge of the middle turbinate. Occasionally one was encountered relatively far back.

When an ostium has been entered for the first time, a note is made on the patient's chart which gives the position and approximate size of the ostium, also its relation to the anterior tip of the middle turbinate. This enables one to locate the orifice more readily and insures a minimum of manipulation the next time the irrigation is carried out.

A calibrator was devised that enabled me to measure the anteroposterior diameter of all the vertically placed ostia that I entered. This measurement ranged from 1.5 to 12 mm.

Irrigation of the maxillary sinus through its ostium has been characterized by many as difficult of execution and often impossible. At times this is so easily accomplished that the operator is surprised. This is particularly so when the upper border of the ostium is above the free edge of the uncinate or when a large ostium occupies all or most of the infundibulum. That it is at times impossible of execution should be readily conceded, for I encountered 15 specimens during the anatomic study in which it was impossible to enter the ostium even with the middle turbinate removed and the lateral wall exposed.

The following conditions might preclude the possibility of entering the ostium:

1. Abnormal distance of the ostium from the free edge of an abnormally prominent or high uncinate.

2. A marked convexity of the septum in the region of the middle turbinate so that its anterior end is out of sight and the middle meatus cannot be entered even after cocainization and shrinkage.

3. The presence of an unsuspected anatomic abnormality.

CONCLUSIONS

An attempt was made to enter the normal ostium in 170 maxillary sinuses. One hundred and thirty-eight, or 81 per cent, were successfully entered, and 32, or 19 per cent, could not be entered. The Pierce cannula and my modification of this instrument were used.

It should be remembered that the ostium lies horizontally, obliquely and vertically. In this series 34 were horizontal, 6 oblique and 98 vertical.

The proximity of the middle turbinate to the lateral wall does not appear to interfere with the passage of a cannula into the maxillary ostium. There may be an occasional exception; in this study there was 1 in 138 instances.

The height or prominence of the uncinate and the depth of the infundibulum do not always interfere with the successful passage of the cannula.

The angle (bulla-uncinate angle) formed by the posterior upward curve of the bulla and the posterior downward curve of the uncinate is the most constant guide to the location of the ostium.

It would appear from this study that irrigation of the maxillary sinus through its ostium is a feasible procedure in a sufficiently large percentage of cases to make it worthy of a trial.

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ABSTRACT OF DISCUSSION

Dr. O. V. Batson, Philadelphia: To me the problem of the irrigation of the maxillary sinuses resolves itself into a consideration of what is advantageous and what is feasible. Since the root of the inferior turbinate is so thin, there is little vertical difference between the upper part of the inferior meatus and the lower part of the middle meatus. Instruments introduced into the maxillary sinus through the technically lower, inferior meatus, because of their upward direction of entrance, frequently are in a higher position in the sinus itself than those introduced through the middle meatus.

It is obvious that Dr. Myerson has developed extreme skill in passing his cannula through the normal ostia. In the absence of this skill, I fail to see why there should be any objection to puncturing the membranous portion of the lateral nasal wall with its two layers of mucosa, when, if the inferior meatal route is used, one traverses two layers of mucosa and the intervening bone. The membranous portion of the lateral nasal wall is removed from the orbital danger zone.

In those cases in which the distance between the lateral wall of the nose and the maxillary sinus brings about an elongation of the ostium, I would speak of an ostial canal, and indicate its direction by saying that it runs from above downward or from within outward.

Dr. George B. Wood, Philadelphia: It is probably due to the influence of Dr. Walter J. Freeman that I have always been interested in the possibility of washing out the accessory sinuses of the nose through the natural ostia. Dr. Freeman's skill in the use of his special hard rubber catheter, which he molded by heat to fit the individual case, was almost uncanny, but I doubt if he ever succeeded in getting into more than 50 per cent of the normal maxillary ostia. Dr. Myerson must be congratulated on his success in the number of cases that he has been able to catheterize.

When one is able to wash out the maxillary sinus through the natural or accessory opening, it would seem to me unwise to resort to other measures that produce more trauma and accomplish only the same thing. Especially in acute cases is the traumatic puncture pregnant of considerable harm. If the pain accompanying acute maxillary sinusitis is so great that some relief must be given, it is better to make a large opening through the inferior meatus than simply a puncture. Also, I have seen a simple puncture through the inferior meatus produce an almost fatal hemorrhage and, frequently, the bleeding is quite considerable. This bleeding may take place into the maxillary sinus as well as into the nasal cavity and must have a deleterious effect on an acute infection. I have never seen any untoward symptoms from washing out a sinus through the normal opening. At times I have found it difficult to be sure that my cannula was in the opening, for after passing the cannula back of the unciform process it suddenly drops into a recess, and this may or may not be the opening of the sinus. If, however, the point of the instrument cannot be pushed backward or rotated inward toward the septum, it is almost surely in the ostium. If when one injects fluid through the cannula, a certain amount goes somewhere and does not appear in the nose, one would presume it has gone into the maxillary sinus. If, after injecting the fluid, a syringe full of air is gently injected, the fluid will reappear in the nose if it is in the antrum.

I am glad to have heard Dr. Myerson's paper and feel that his anatomic investigations and technic will make this rather valuable procedure applicable to a larger number of patients.

Dr. Henry Dintenfass, Philadelphia: Diseases of the maxillary antrum play such an important rôle, not only in the practice of rhinology but in medicine in general, that any method that will facilitate the study and investigation of this sinus is to be welcomed.

The subject has been ably covered. Of the five methods mentioned of entering the antrum, alveolar irrigation and puncture of the canine fossa may be disregarded, leaving for our discussion, first, the inferior meatal puncture, the most popular today; second, the middle meatal puncture recently reintroduced by Yankauer and Goldman of New York, and third, the irrigation of the sinus through the natural orifice, which is the subject of this symposium. Since the middle meatal puncture can in some respects be placed in the same category as the inferior meatal puncture, it will not be dealt with here. This narrows the field to the remaining two methods, i. e., puncturing the inferior meatus and catheterizing the natural orifice. Let us take up the advantages and disadvantages of each, and in so doing decide whether the former, which is the most frequently employed, should be supplanted by the latter, so successfully performed by Dr. Myerson.

In stressing the arguments in favor of the meatal puncture, the following should be noted:

The procedure is simple to perform.

A straight needle of the Lichtwitz type thrust between the attachment of the inferior turbinate and the lateral nasal wall in the inferior meatus in a direction toward the posterior part of the eyeball of the same side will enter the antrum without difficulty. Little previous experience and no special knowledge of anatomy are required in this procedure.

The procedure is successful in practically all cases. Unless the inferior turbinate hugs the lateral wall closely, and even then it can be refracted or pushed over, the needle will find its way into the antral cavity in almost every instance.

What are the drawbacks to this procedure?

There is danger of air embolism. While this complication is rare and in the opinion of many observers does not exist, not a few cases have been reported following needle puncture which resulted fatally.

There is danger of hemorrhage. In several instances, inferior meatal puncture has occasioned bleeding severe enough to necessitate ligation of the external carotid.

Shock is another danger. Where the antral wall is very thick, it is sometimes necessary to use a mallet to force the needle through the bone into the sinus. The effect on a nervous person may be quite severe.

In the majority of cases there is an absence of pain, yet occasionally a patient will experience great discomfort in the cheek, eye and even frontal region.

In considering the advantages of the ostial catheterization over the meatal puncture, it is at once apparent that the foregoing dangers, air embolism, hemorrhage, shock and pain, are completely eliminated. Sliding the cannula through an opening instead of necessarily piercing the tissue, bony or otherwise, does away with these difficulties and objections and is appreciated by the patients in whom the antrum has previously been punctured. To this may be added the fact stressed by Yankauer, that in children the natural opening is relatively larger than in adults, which makes this method particularly applicable in the young.

However, the practicability of using the natural ostia for irrigation has certain definite limitations. For example:

A markedly deflected septum will preclude the possibility of entering the ostium.

Where the position of the middle turbinate is low, the hiatus, bulla and uncinate may be obscured and the hiatus made inaccessible, especially if there is pathologic mucosa in this region.

If the uncinate process is high, that is, over 5 mm., the ostium is hidden and it is impossible to pass a cannula or bent probe from the anterior nasal orifice.

When the bulla covers the whole of the hiatus, the introduction of a sound in the infundibulum, and particularly in the maxillary antrum, may be quite impossible.

Again, if the infundibulum is unusually deep and narrow, failure may result.

The variable positions of the ostia have also been mentioned and present another problem. This anatomic peculiarity has been overcome to some extent by the Myerson modifications of the Pierce cannula, which I have recently used with considerable success and by means of which the horizontally and obliquely placed ostia, usually the most difficult to sound, can be entered more easily. The vertical ostium is quite accessible and can be sounded by the single curved instrument of the Siebenmann type. Dr. Robert Hunter, of Philadelphia, informs me that he uses this instrument with good results.

Because of the close relationship of the orbit to the middle meatus, the improper introduction of the instrument may result in forcing it into the orbital cavity. This is apt to occur, as the essayist emphasized, if the cannula is placed anterior to the ostium.

Another difficulty may arise if the cannula fits the ostium too closely, since there may be insufficient room around the instrument and the return flow obstructed, reference to which has been made. On the other hand, if the ostium is too large, there is a tendency for the cannula to slip out of the opening during irrigation, necessitating the help of an assistant to hold it in place.

It is obvious then that in the procedure of ostial catheterization not only is a thorough knowledge of the anatomy of the lateral nasal wall essential, but also great care and patience, together with some degree of skill and experience. This would partly account for the difference in opinion regarding the percentage of successes. Schaeffer contends that only a very small percentage can be sounded, and that the procedure is only successful in those patients in whom the ethmoidal bulla is small and the uncinate process is narrow with a resultant shallow and wide mouthed infundibulum. Myerson and others maintain that 80 per cent is about the proper figure. In my own experience about 50 per cent of the normal ostia were entered. However, when catheterization is easily performed, it is surprisingly so, and for this reason alone should be tried in every case before inferior meatal puncture is resorted to. It should also be noted, and in this we agree with the author, that ostial irrigation should not be attempted in acutely inflamed antrums because of the possibility of mixed infection following the introduction of the irrigating fluid.

Only slight reference has been made to accessory ostia, but it is well known that they do exist, particularly in adults. According to Schaeffer, they afford a more direct communication between the maxillary sinus and the middle nasal meatus; they are frequently of good size and more advantageously placed as a drainage and exploring point of the maxillary sinus than is the regular maxillary ostium which is located farther cephalically and in the depth of the narrow infundibulum ethmoidale. Moreover, he points out that their incidence of occurrence as given by Giraldès, and so commonly referred to in textbooks, is far too low. Therefore, it seems logical to suppose that in catheterization the cannula often enters the accessory ostium instead of the natural opening. Although the end-results are the same, how can one be sure that such is not the case?

Before arriving at a conclusion as to whether natural ostial catheterization or inferior meatal puncture is the method of choice, may I reiterate the essayist's statement that "Dropping the cannula into a hole, when it is easily done, cannot be compared to puncturing a bony wall, however thin."

DR. J. PARSONS SCHAEFFER, Philadelphia: The variations in the maxillary ostium referred to by Dr. Myerson and Dr. Batson, I have noted many times. These variants are to be expected and are in accord with the genetic potentials as illustrated in my embryologic reconstructions of the aperture.

The following factors favor the maxillary ostium as an approach: (1) it is the natural and physiologic aperture of the maxillary sinus; (2) it is always present in some form, and (3) its major relations are fairly constant, the ethmoidal bulla, the uncinate process and the ethmoidal infundibulum pointing the way.

Because of unusual size and peculiar conformation, the latter structures may, of course, block the way to the ostium. The size and the location and direction of the maxillary ostium or canal may prevent free passage into the maxillary sinus despite the fact that the ethmoidal infundibulum may have been successfully entered by the operator.

In my early studies (1907), I was of the opinion that in the majority of cases it was impossible to sound the maxillary sinus through its natural aperture without some injury to the margin of the ostium and the undefended floor of the ethmoidal infundibulum; that free sounding was possible only in those cases in which the ethmoidal bulla and the uncinate process were altered in shape and reduced in size, resulting in a shallower and wide-mouthed ethmoidal infundibulum. Size and exact location of the maxillary ostium were noted as important factors in freely sounding the maxillary sinus.

The anatomy has not changed since 1907, but instruments of precision and a more highly refined technic have come into being. That Dr. Myerson will succeed beyond our earlier experiences and be successful in more cases than operators who have not given the several problems involved (an understanding of the underlying anatomy, suitable instruments, and a highly developed technic) adequate thought, goes without saying.

While I am in favor of using the maxillary ostium, I cannot help but feel that when so large a percentage of successful soundings of the maxillary sinus by way of the maxillary ostium are reported, the accessory maxillary ostium was utilized unknown to the operator in a good number of instances. It would also appear that the maxillary ostium was not always freely entered, resulting in injury to the ostium or the floor of the ethmoidal infundibulum. This may not matter; however, it has never been clearly determined whether or not such injuries lead to scarring, contractions and adhesions. Enough damage might be done by those not properly trained to bring about closure of the maxillary ostium.

DR. R. G. REAVES, Knoxville, Tenn.: For twelve years I irrigated the maxillary sinus through the middle meatus. I do not know how often I entered the natural opening in the middle meatus, probably sometimes an accessory opening, maybe more often than the natural. I am very glad to hear Dr. Schaeffer say that he believes the accessory opening is a developmental opening and not due to a pathologic process. During ten or twelve years of examining these cases and seeing this opening, I question the patients carefully and they all give a history of having had maxillary infection previously. I came to the conclusion that the condition was due to a pathologic process but that the pus had broken through the thin membrane and left a permanent opening. I may be wrong, but that was my conclusion.

In getting into the middle meatus a good deal of the difficulty has been overcome by the flexible cannula I use. I bend it, and if I am not able to go through the opening present I puncture through the thin membranous portion. Sometimes I have to puncture the bone in the middle meatus. For the last two years I have continued to try to go through the middle meatus and if possible by the opening present, because there is no question that if one can get through this opening, the results are better, and it certainly is much easier on the patient. If there is some difficulty in entering the middle meatus, I now use the needle puncture in the inferior meatus. I try to choose the easier route of the two.

Dr. Myerson spoke about the use of epinephrine. I question the advisability of using this drug. I used it, but it caused a bad after-reaction, as shown by Dr. Fox in Chicago. As a matter of fact, there occurs an infiltration of tissue, serum, white cells and red cells, just like an infection, and that would certainly tend to prevent drainage, which one does not want to happen. As to the return flow, it makes no difference how the meatus is entered as a return flow results just the same, but it is much better if it can be done without trauma. Avoid trauma in the middle meatus if the frontal sinus is involved.

Dr. M. C. Myerson, New York: A good many of the points raised in the discussion are covered in the paper. For instance, I never irrigate an acutely inflamed antrum by any method.

Dr. Batson speaks of inadequate counterdrainage. He, being an anatomist, knows there are from 10 to 50 per cent of accessory ostia present in all noses, and that would allow for counterdrainage to a considerable extent. In 138 antrum irrigations, we had no difficulty with counterdrainage.

I should like first to pay my respects to Dr. Schaeffer and to express my appreciation of what he has done for a better understanding of the anatomy of the paranasal sinuses, but I must insist that clinical experience added to anatomic knowledge might have given him a little different point of view on the subject under discussion. I contend that the variation in the size of the ostium does not interfere with its being entered. When the ostium is small, it does not matter whether it occupies the entire infundibulum or only part of it. If one is technically able, he can enter this ostium in a good percentage of cases.

As to the question of trauma when one enters the ostium, Dr. Schaeffer speaks of injury to the wall of the passage-way. If it did occur it would compare with the necessary trauma when an antral wall is punctured. If one enters the ostium and injures the walls, there should be bleeding if fibrotic changes are to occur, and if there is bleeding, blood will be seen when the fluid is returned.

I am glad to hear Dr. Schaeffer admit that 25 per cent of maxillary ostia can be entered, because in his book he does not admit so much and I appreciate his more favorable attitude in this matter.

The paper confined itself to the clinical phases of the maxillary ostium, the idea being only to feature the procedure that enabled us to enter the maxillary sinus without undue injury to the tissues, certainly without as much injury to the patient as we have with other methods of entering the maxillary cavity. What difference does it make whether one gets into the infundibulum, or whether one goes outside of it and gets into an accessory ostium, if in doing so his procedure gives the patient the least amount of trauma and discomfort.

I am happy that this paper has caused so much discussion. I am sure it will stimulate us to think on the subject a little more in the future, and if it is worth while we may use this method more frequently.

RELATIONSHIP OF ORAL AND PHARYNGEAL ABNORMALITIES TO SPEECH

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The production of vocal sounds or phonation depends on the perfect working of all parts of the speaking machine as one might call the associated activities of the thorax, trachea, pharynx, oral and nasal cavities, the jaws, teeth, roof of the mouth, and lips. These tissues are helped by the actions of the diaphragm with the pharngeal, palatile, lingual, labial, buccinator, hyoid and masseter muscles, as well as the vocal cords.

Speech sounds therefore may be said to be produced by the passage of expired air through an elastic tube composed of various tissues, no single structure or muscle serving speech alone. Complete closure of every passage to the nasal chambers is necessary for perfect utterance of many vocal sounds. In other words, the quality, timbre or type of sounds produced depends on the ability of the tongue and velum to stop the air column as needed. The production of even a single sound is a very complex act involving the use of and coordination of every part of the speech apparatus as well as the activating mechanism, the nerve centers in the cerebrum and other parts of the brain. Any variation from the regular condition of these tissues causes changes in speech which may or may not be classified as a speech defect, depending on the point of view of the individual.

A voice abnormality may be defined as any unusually conspicuous deviation from the usual speech pattern. This defect may be caused by one of two things: changes in the nerve system or abnormalities in the air passage. Case [1] said: "As the column of the speaking breath passes up the throat and through the mouth it comes under the influence of certain definite muscular movements and restrictions which force it into certain channels to mold speech." Therefore, from an oral and pharyngeal standpoint, any obstruction or abnormality of tissue may cause a speech defect.

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1. Case, C. S.: The Physiologic and Phonetic Principles of the Art of Speaking, Dental Orthopedia, 1921, p. 420.

The classification of these changes in speech are more or less dependent on the observer. Travis [2] grouped them into seven classes: (1) dysarthria, or those defects due to lesions of the nervous system in which are found inarticulateness, labored speech and ataxic speech; (2) dyslalia, under which are found lisping, mutism, delayed speech and uraniscolalia or cleft palate speech; (3) dyslogia, or difficulties in expression of ideas by speech, incoherent speech and those defects due to different psychosis; (4) dysphasia, or the impairment of power of language due to weakened mental imagery, grouping speech being a typical example; (5) dyshemia, being the defects due to psychoneuroses or those caused during fright or height of passion, stuttering and stammering coming in this group; (6) defects of voice itself, as aphonia or voicelessness, baryphonia or thick voice, hypophonia or whispering and rhinophonia or nasal voice; (7) dysrhythmia, or the defects of rhythm other than stuttering. The defects of rhythm in breathing are typical examples. Many of the foregoing defects never come under the observation of the physician or oral surgeon since they cannot be treated by means other than speech training. Others can be helped by placing the speaking mechanism in good condition, that is, by the surgical or medical removal of organic malformations and the treatment of psychoneurotic changes in physical conditions.

The most pronounced of the defects needing surgical correction is that caused by the cleft palate. Cleft palate speech, or uraniscolalia, is characterized by the nasal pronounciation of all vowel sounds and the inability to pronounce T, D, P, G, K and hard G, hard C, F, V, L, R, S and Z. For example, those persons afflicted with this deformity make the word *take* sound like *kake; doctor* is *gok-kor,* and *did* becomes *gig.*

This type of speech is due to the lack of solid drum-head-like resonancing surface normally produced by the hard palate with the nasal cavity and sinuses above, along with the inability of the velum to articulate with the tongue or close the nasal chambers. This defect in the speaking mechanism permits the escape of the air column into the nasal cavity. Owing to the abnormality in the shape of the palate, the tip of the tongue becomes practically useless until trained. Further difficulty is encountered because of the often associated cleft upper lip.

Many surgeons still believe that their operation to close the cleft palate is a success when they obtain a union of the parts without perforation. However, the result of such operations is often nothing more than a much scarred velum which is definitely shortened and rigid. Such a soft palate is of little or no value in the production of correct vocal sounds. The more recent technic of operation arrives first at the

2. Travis, Lee Edward: Speech Pathology, New York, D. Appleton and Company, 1931.

restoration of normal position and usefulness of the tensor palatini, azygos uvala, palatopharyngeus, palatoglossus, levator palati and constrictor pharyngeus superior muscles so that the velum is soft and flexible and can fulfil its purpose. If the velum cannot be made long enough in the first operation, a subsequent one, often called the push-back, must be resorted to which aims to drop it back further, in other words, to lengthen it. Scar tissue is minimized because old style retention plates and cut muscles have been done away with.

The operation for the correction of this deformity should start soon after birth when clefts of the lip are repaired and the hard palate approximated. It is advisable to wait until the child is nearly 2 years of age before the soft palate is repaired, and so one often finds some speech defects even in the cases in which operation has been performed at the earliest possible age; however, these defects are few and quickly corrected. Unfortunately, many of the cases do not reach the surgeon until the speech habits are formed. It is well to emphasize in such cases that no matter how successful the closure of the palate, surgical measures alone will not correct the speech defects, special training being necessary.

Other abnormalities of the speech tract or mechanism that need medical and surgical attention include tumors of the tongue, abnormally long or thickened uvula, bifid or double uvula, improper development of the palate, enlarged tonsils and adenoids, nasal polypi, deviation of the nasal septum, hypertrophied turbinates, stenosis of the larynx, chronic laryngitis, sinus disease, postdiphtheritic paralysis, perichondritis of the laryngeal and nasal cartilages and defective hearing. One must qualify the foregoing statements with the realization that the degree of speech disturbance depends on acuteness and magnitude of the affliction to the speech tract. For example, the diagnosis of laryngeal cancer, and total laryngectomy as a treatment, seems on the increase with the development of the need for training in the production of a pseudovoice for these otherwise speechless patients.

The tongue is an important factor in speech, and it rapidly adjusts itself to all the positions needed to make the correct type air column or air stop to form nearly all the vocal sounds. However, the tongue may be completely removed without losing all the power of speech as some seem to think. Theoretically, the tongue affects all speech, but it is a marvellously adaptable organ. Tongue tie, changes in tongue size and tumors of the tongue usually do not produce any change in speech other than giving it a thick rather indistinct tone. Changes in the size of the uvula usually cause a rather muffled speech in that the swollen or enlarged tissue acts almost like a foreign body in the pharynx. Intranasal obstructions interfere with the resonance necessary to the correct sounding M and N. Enlarged tonsils and adenoids interfere with the

relaxation of the soft palate and give a nasal sound to all words. Defective hearing affects speech whether it is congenital or acquired. Abnormalities of the lips other than excessive scarring or unoperated clefts do not cause noticeable disturbances in speech.

From a dental standpoint alone there are many possible causes for speech defects, most of which can be corrected quite easily. The removal of all of the teeth naturally changes the position of the arches and takes away some of the limitations of the tongue. Dentures should be made with the idea of restoring some of the fineness of speech as well as restoring masticatory surfaces. The placing of a thick sheet of vulcanite or other material over the palate may lessen the natural resonance of that tissue and places a strange surface for the tongue to become acquainted with.

The mandibular dentures should be constructed so that the tongue does not have to lift itself consciously to function, which, of course, produces disturbances in voice sound. Stability of the dentures is of paramount consideration. It is well to realize that some people seem to have little or no ability or perhaps make no effort to learn or acquire new habits of mastication following the loss of their teeth; this being also true of speech.

The restoration of the teeth with a short bite, or thick incisors, causes speech defects. The lateral escape of air produces a hissing S and may develop when teeth are lost. An open bite affects all sounds with the exception of the vowels, while spaced teeth often cause lisping. Prognathism of the upper teeth affects the pronunciation of S. A retrocluded bite affects the F, V, P, B, M, W and O sounds. An overbite affects S, T, TS, Z and D. Obtruded anterior teeth affect the development of correct sounding F, S, Z, U, P, O, B and A; intruded teeth, S, T, Z and D.

The defects that might be classified as stuttering, stammering, falsetto speech and perhaps lisping in numerous instances have been attributed to fear, cerebral congestion, lagging respiration, defective auditory or visual memory and anatomic malformations of the speech organs. Appelt, Stehel, Coriot, Deltner and Travis have worked on the theory that these defects are deep-seated and of a neurophysical or psychoneurotic character. Their advised treatment is that of directing energies of the patient into new paths and the correcting of neurosis There are many cases of stuttering, stammering, lisping and similar defects that develop after operative procedures on the palate and after orthodontic corrections that seem to bear out the neurophysical nature of this type of pathologic speech. At the same time a number of these cases develop as the result of focal infections and clear up when the infections are treated and removed.

The subject of speech defects covers so many ramifications that it is impossible to more than touch lightly on some phases in this paper. It has been pointed out that the physician and oral surgeon can often do much to put the speech apparatus in good condition, after which the teacher is needed to give the patient the best speech possible with what is available. Speech defects should receive more attention than they have been given, for there is a great service to be rendered to this type of patient, who so often suffers also from personality deficiencies, social handicaps and mental and physical disorders directly attributable to his abnormal speech.

EXTERNAL OPERATION ON THE FRONTAL SINUS

CAUSES OF FAILURE

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ROCHESTER, MINN.

That the final results from radical operation on the frontal sinus have not been uniformly successful is indicated by the many types of operation and the variations in technic that have been devised to overcome the unfavorable results.

Although Galen mentioned the porosity of the bones of the head, "making them of little weight," in several of his writings about the year 691, Vesalius first described the frontal, maxillary and sphenoid sinuses, but both Fallopius and Vesalius credit Galen as the first to have noted the existence of accessory nasal sinuses.

However, there is no evidence that these sinuses were in any way associated with disease even by surgeons of an earlier day who were familiar with them through the care of fractures of the skull involving the frontal sinuses. I have not found mention of the intentional opening of the sinuses, although it was done apparently inadvertently during treatment of fractures of the skull. In 1564, Ambroise Paré warned against opening the frontal sinuses while trephining the skull in the treatment of fractures of the frontal bone, "because they are filled with a white, sticky fluid as well as air." Morgagni referred to Lettre as having conceived the idea of trephining the frontal sinus in disease conditions as early as 1704. Apparently little progress in diagnosis or treatment of disease of the frontal sinus was made until the latter part of the nineteenth century.

About 1890, Schaeffer [1] proposed draining the frontal sinus through the nose by enlarging the nasofrontal duct. In 1891, Baumgartner, Monatz, Greenwald and others wrote on the subject of diseases of the frontal sinus. Most of these writers advocated trephining the sinus externally. About the same time, Winkler [1] and Scheier [1] demonstrated

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1. Quoted by Wright, Jonathan: A History of Laryngology and Rhinology, Philadelphia, Lea & Febiger, 1914, p. 357.

by anatomic studies the surgical relation of the frontal sinus to the upper nasal passage, proving that, as a rule, it was practical to approach the frontal sinus by the intranasal route. However, the drift of opinion, for many years, seemed to have been toward gaining access to the sinus by means of some form of external operation.

In 1884, Ogston operated on the frontal sinus by an angular incision. A vertical incision was made along the wrinkles between the eyebrows which met a horizontal incision parallel to the wrinkles of the brow. The skin and periosteum were raised; a trephine was applied to the bone, and the contents of the cavity were exposed. This was the procedure used in one case; later, he made an incision about 3.75 cm. long, commencing at the root of the nose and extending upward in the central line of the brow.

The Luc type of operation was similar to Ogston's, and it has been referred to as the Ogston-Luc operation. Luc,[1] however, employed curettage and inserted an intranasal drain. Kuhnt [1] removed part of the interior wall of the sinus, which produced such deformity that the operation never met with favor from either the patient or the surgeon. Jansen devised a procedure in which he made the incision along the margin of the orbital ridge, opening the sinus from below and removing the entire orbital roof and also enlarging the nasofrontal duct.

In 1895, Killian [1] described his method of incision through the eyebrow and preservation of the upper orbital arch. In 1902,[2] he further elaborated the method. Complete exposure of the frontal sinus was obtained, and less deformity of the forehead was the result. By prolonging the incision down below the inner angle of the eye, he obtained exposure, permitting curettage of the anterior and posterior ethmoid cells and the sphenoidal sinuses.

Luc and many other surgeons [3] in England and on the continent of Europe soon adopted this method of dealing with frontal sinuses. In 1911, Ritter,[1] Jacques [1] and Luc reported favorable results from an operation in which the whole anterior wall of the frontal sinus was preserved and only the lower or orbital wall was removed. In this period, many surgeons in the United States and in Europe were advocating intranasal operations for the cure of suppurative frontal sinusitis in preference to the external operation. Among these surgeons

2. Killian, Gustav: Die Killian'sche Radicaloperation chronischer Stirnhöhleneiterungen: II. Weiteres kasuistisches Material und Zusammenfassung, Arch. f. Laryng. u. Rhin. **13**:59, 1903.

3. Krauss, Leonhard: Die Killian'sche Radicaloperation chronischer Stirnhöhleneiterungen: I. Historische Entwickelung der Methode an der Hand der Casuistik bearbeitet, Arch. f. Laryng. u. Rhin. **13**:28, 1903.

were Ingals,[4] Casselberry,[1] Skillern [5] and Halle.[6] There is evidence in support of the contention that in most cases of suppurative frontal sinusitis, the intranasal operation is the method of choice.

In 1914, Lothrop [7] described his modification of the external operation. In 1916,[8] the technic of Beck's osteoplastic operation was published. In 1908, Skillern introduced a "modification of the Jansen operation." "The principals of the operation are to spare the anterior wall but to obtain the requisite space by resecting the superior internal portion of the margin of the orbit and the floor of the sinus, thus exposing the entire lower portion or funnel of the frontal sinus."

In 1921, Lynch [9] brought out a modification of the operation advocated in 1911 by Ritter, Jacques and Luc, which in his experience has proved satisfactory.

TECHNIC IN PRESENT STUDY

In my series of cases the methods used were modifications of the Killian and Lynch operations. When there had been considerable destruction of the anterior wall, sequestrums or osteomyelitis were present, or when the roentgenograms showed the sinus to be very large and divided into several cells, a modification of the Killian operation was used. The most essential factor in producing complete cure and in preventing objectionable deformity in this type of operation is the careful beveling off of all edges of bone and the smoothing out of all irregular surfaces, allowing the skin and periosteum to obliterate the cavity completely, as advocated by Lillie and Anderson.[10]

In cases in which the disease extended into the orbit without evidence of disease in the anterior wall of the frontal sinus and the sinus was of such size and conformation that it could be reached without removal of the anterior wall, the Lynch type of operation was used, as the chance

4. Ingals, E. F.: Intranasal Drainage of the Frontal Sinus, J. A. M. A. **50**: 1502 (May 9) 1908.

5. Skillern, R. H.: The Advantages and Disadvantages of the Endo-Nasal Method of Operating for Empyema of the Frontal Sinus, Laryngoscope **18**:439 (June) 1908.

6. Halle, Max: Die intranasale Eröffnung und Behandlung der chronisch-kranken Stirnhöhlen, Arch. f. Laryng. u. Rhin. **24**:249, 1911.

7. Lothrop, H. A.: Frontal Sinus Suppuration with Results of New Operative Procedure, J. A. M. A. **65**:153 (July 10) 1915.

8. Beck, J. C.: External Frontal Sinus Operation, J. A. M. A. **67**:1811 (Dec. 16) 1916.

9. Lynch, R. C.: The Technique of a Radical Frontal Sinus Operation Which Has Given Me the Best Results, Laryngoscope **31**:1 (Jan.) 1921.

10. Lillie, H. I., and Anderson, C. M.: The Two-Stage Operation for Suppurative Frontal Sinusitis with External Manifestations, Arch. Otolaryng. **5**:152 (Feb.) 1927.

of external deformity was lessened. In both types, the intranasal and external operations were done in two stages. This procedure has proved satisfactory because it frequently makes the external operation unnecessary; the second stage, when needed, is more easily accomplished, and the duration of the anesthesia is shortened.

In order to formulate a more definite working basis for correction of the unfavorable results of operation on the external frontal sinus, an analysis was undertaken of the causes of failure in cases in which the primary external operations had been done elsewhere, or in which the patients had returned, after the primary operation, for further attention.

In this series of cases the patients had been operated on by the external radical method, and cure had not been obtained. Patients who had been relieved from all symptoms and had not had a recurrence were not included. If the patients had been operated on elsewhere, it was often impossible to determine the type of operation that had been performed. In this group, the principal cause of failure was incomplete operation externally as well as intranasally. In a large number of cases the intranasal operations had been incomplete, with failure to establish adequate drainage after an external operation had been performed; otherwise, the operation might have proved successful. An even larger proportion of failures was due to incomplete external operations, which allowed the formation of pockets with poor facilities for drainage and formation of granulation tissue, which in turn produced obstruction and a recurrence of symptoms that were often more serious than the original complaint.

In order that patients may be relieved of all symptoms with reasonable certainty, the modified Killian operation should be employed. The essential factor in the success of the operation is care in beveling all the edges after removing the entire external wall of the sinus in order to obliterate the sinus space completely. If any of the depression or overhang is left, a pocket is likely to form in which infected granulations will cause trouble later, or possibly prevent proper healing. In addition to this, an adequate nasofrontal duct should be provided with sufficient bone surrounding it to prevent contraction of skin, and to prevent the other soft parts from closing off drainage from below. Careful attention to the intranasal stage of the operation will add greatly to the ultimate success of any type of external operation on the frontal sinuses. If the septum is deflected toward the affected side, it should be corrected. The agger nasi, bulla ethmoidalis, anterior ethmoid cells and the anterior portion of the middle turbinate should be taken down to the orbital wall, thus providing more room for enlargement of the nasofrontal duct, and also making it possible to secure more dependent drainage. In this manner,

sufficiently large ducts have been made, in a number of cases by the intranasal route, to admit the small end of a Faulkner ring curet. A number of apparently successful external operations were converted into complete cures by this type of secondary operation. The deformity of the forehead following this operation, when all raised edges and depressions have been smoothed out, is not marked, and, as a rule, it should not be a contraindication to the operation. If the cosmetic effect is a consideration and a valid reason for not performing any type of obliterating operation, there is greater risk in obtaining an unfavorable result.

Tabulation of Cases

Causes of Failure	Primary Operation in Present Series	Operation Elsewhere	Secondary Operation in Present Series	Total
Incomplete external operation	2	23	1	28
Incomplete intranasal operation	5	6	1	12
Incomplete external and intranasal operation	..	12	..	12
Collapse of soft parts	1	1	6	8
Contracture of nasofrontal duct	5	1	..	6
Sequestrum	..	3	2	5
Osteomyelitis	2	3	1	6
Reinfection after apparent cure	..	..	1	1
Orbital abscess	..	2	..	2
Granuloma, undetermined type, and osteomyelitis	..	1	..	1
Polypi, granulation tissue and incomplete operation	..	3	..	3
Regeneration of bone (osteitis)	..	1	2	3
Meningitis	2	..	..	2
Foreign body	1	1	..	2
Membrane over nasofrontal duct	1	..	..	1
Edges of bone not beveled	..	1	2	3
Incomplete operation and mucocele	..	2	..	2
Fronto-ethmoidal cells overlooked	2	..	..	2
Epithelioma	1	..	..	1
Collapse of soft parts and contracture of nasofrontal duct	1	..	..	1
Total	23	62	16	101

In this series of cases, the principal reason for failure in the Lynch type of operation appeared to be the contracture of the nasofrontal duct with retention of the secretion in the sinus. If an attempt is made to provide a larger opening into the nose by removing the bony structure anterior to the nasofrontal ducts, the skin and soft parts are likely to collapse into the cavity and cause obstruction. When the floor or too much of the anterior wall of the frontal sinus is removed, the same condition results. Theoretically, the soft parts should eventually fill the sinus cavity, producing the same effect as in a Killian type of operation. This ideal result is rarely obtained. Instead of total obliteration of the sinus, the cavity is only partially filled, the pockets remain, and symptoms continue. In order to prevent this, it would seem best to preserve as much of the bone surrounding the sinus cavity as possible,

and provide ample drainage through the nasofrontal duct, which is enlarged in the same manner as for the obliterating type of operation. The lumen of the duct should be maintained by means of some forms of drainage tube for a sufficient length of time to obtain a lining membrane and complete organization of the tissues surrounding the duct. Some surgeons advocate leaving the drain in place for six months.

In the series reviewed there were 161 cases of suppurative frontal sinusitis for which operation was indicated. Among these were 112 in which some type of external operation had been performed. In 62 of the cases some form of external operation had been performed elsewhere, and in 50 it had not. In all of the former group and in 23 of the latter, operation was again performed. Sixteen of the patients were not completely relieved (see table).

SUMMARY

In certain cases failure to obtain a good result could not be avoided and had to be accepted as part of the necessary risk encountered in any type of operation. However, a large percentage of failures was due to improper operative procedure. It would seem that, in acute infection, a greater chance of successful results would be assured if operation could be delayed until the acute stage has subsided and some immunity to the infection has been established. The majority of patients suffering from osteomyelitis of the skull gave a history of having been operated on during the acute stage of the disease.

Because of the great variation in number and distribution of ethmoid cells, it is necessary to make a careful study of roentgenograms previous to operation and to follow carefully any lead which might indicate the presence of cells in unexpected areas.

If the intranasal portion of the operation is performed a considerable time previous to the external operation, one is better able to determine the source of the infection and to avoid overlooking such complications of frontal sinusitis as pyocele or mucocele of the ethmoid or antrum which may be connected with the sinus directly. If bony structures are operated on, sequestrums may form from uncontrollable causes, but careful attention to the removal of all diseased bone and smoothing off sharp or uneven surfaces which may become detached owing to lack of nutrition, or from raising of the periosteum beyond the limits of removed bone because of their becoming partly loosened during the operation and allowing infection to undermine them, should reduce the complications to a minimum.

The selection of the type of operation to be employed in any given case is extremely important and should be suited to the particular problem presented. If there has been considerable destruction of the outer wall of the sinus, changing the contour of the face is not a serious

consideration, and the patient must be assured of a relatively high percentage of cures; in such cases the Killian type of operation is employed. If the normal contour of the forehead must be preserved even at a greater risk of not obtaining an entirely satisfactory result, some type of operation which preserves the anterior wall of the frontal sinus should be selected. The bony walls should be preserved sufficiently to prevent collapse of the soft parts, and the nasofrontal duct should be maintained by means of a drainage tube for a long time. The two-stage operation in which the intranasal portion of the operation is done a considerable time prior to the external operation has proved of great value.

CONCLUSIONS

The principal preventable causes of failure of the external operation on the frontal sinuses in the group of cases studied were:

1. Incomplete operation.

2. Failure to obliterate completely the sinus cavity in the Killian type of operation.

3. In the Lynch type of operation, the collapse of the soft parts and contracture of the scar closing off the nasofrontal duct.

4. Failure to provide adequate room for proper drainage through the nose.

5. Failure to maintain the nasofrontal duct long enough after the operation.

6. Too early surgical intervention in acute infections.

7. Failure to remove completely all the ethmoid and fronto-ethmoid cells connected with the frontal sinus.

TOXOID IN THE TREATMENT OF ATROPHIC RHINITIS

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The methods described for the treatment for atrophic rhinitis are numerous and include varied vaccines developed on supposedly specific bases. The best known of the earlier preparations is the one described by Perez, who isolated an aerobic bacillus as the specific etiologic agent of ozena. Hofer subsequently found an anaerobic form of this same bacillus, and modified the original Perez vaccine by the addition of this anaerobic organism. Neither preparation has given satisfactory clinical results.

In 1922 Malherbe and Dujardin-Beaumetz [1] also reported that a study of the bacterial flora of the nose in ozena revealed a predominance of the pseudodiphtheritic bacillus of Belfanti and that, on the basis of this observation, they had administered large doses of diphtheria antitoxin with excellent clinical results. They were forced to abandon this method of treatment, however, because of the occurrence of unfortunate anaphylactic complications. In 1927 these same workers [2] described a method for the preparation of a vaccine from an emulsion of pseudodiphtheritic bacilli of Belfanti. They reported that crusting and odor were controlled by the administration of this vaccine. However, Frank's [3] results in a series of cases in which this emulsion was employed were most disappointing, and my own experience with the same preparation proved to be of a similar nature.

After the discovery of the diphtheria anatoxin of Ramon, Malherbe [3a] employed this serum in the treatment of patients with ozena, and reported brilliant results. He believed that he obtained these results because atrophic rhinitis was in the nature of a chronic diphtheria due to the pseudodiphtheritic bacillus of Belfanti, and that the local pathologic process in the rhinopharynx was due to a toxin liberated by this organism. He further reasoned that this toxin was absorbed, causing alterations of the glands of internal secretion, especially of the ovaries,

Submitted for publication, Dec. 11, 1931.

1. Malherbe and Dujardin-Beaumetz: Cong. internat. d'otol., July, 1922; Compt. rend. Soc. de biol. **90**:459, 1924.

2. Malherbe and Dujardin-Beaumetz: Thèse de doctorat, Alépée, June, 1927.

3. Frank, Ira: Personal communication to the author.

3a. Malherbe: Pathogénie de la rhinite atrophique ozéneuse, Presse méd. **35**: 1572 (Dec. 24) 1927.

which are most susceptible to toxic damage. This factor offered him an explanation for the frequency with which ozena occurs in women, and for the influence of certain genital manifestations on crust formation and odor, such as their increased severity at the time of menstruation. The recognition of this endocrine dyscrasia prompted Malherbe to combine organotherapy with vaccine therapy in his cases of ozena. At the present time the combined therapy is widely used in France, both for the active treatment in ozena and for prophylaxis. With regard to the latter, smears are made from the rhinopharynges of school children and toxoid is administered in all instances in which the bacillus of Belfanti is found predominantly in the flora, even though no signs or symptoms of ozena or any other nasal disease are found.

In an effort to establish Malherbe's contention that the bacillus of Belfanti was specific in the genesis of atrophic rhinitis, I introduced pure cultures of this organism into the nasal chambers of rabbits. The instillations were repeated at forty-eight hour intervals over a period of fourteen days. Seventy-two hours after the initial instillation, the animals showed microscopic and macroscopic evidence of an acute inflammatory process involving the mucous membrane of the nose and nasopharynx. This process persisted through the fourteen days during which the instillations were made, but seventeen days after the final instillation the last animal had completely recovered. Although the nasal flora of two rabbits showed a predominance of the pseudodiphtheritic bacillus for twenty-six days, no further gross or microscopic changes developed. The attempt to produce an atrophic rhinitis with the pseudodiphtheritic bacillus of Belfanti was a complete failure. This work was corroborated by Benciolini,[4] who recovered the Belfanti bacillus from the crusts, trachea and bronchi of persons suffering with ozena. However, as the mucous membrane of the trachea and bronchi did not show atrophic changes on direct inspection, Benciolini concluded that this bacillus was incapable of causing atrophy. Previously atrophic rhinitis had been produced experimentally in animals by Hofer, who worked with the Perez bacillus.

The observation of an endocrine dyscrasia in the etiology of ozena has been recognized for a number of years. In 1917 Beck [5] called attention to an underlying internal secretory dysfunction, and reported that although the administration of glandular extracts was often ineffective, occasionally striking results were obtained. Recently Glasscheib [6]

4. Benciolini, F.: Bacterial Flora of the Tracheobronchial Tree in Ozena, Ztschr. f. Hals- Nasen- u. Ohrenh. **28**:550 (Aug. 20) 1931.

5. Beck, Joseph C.: Relation of the Glands of Internal Secretion to Otolaryngology, Laryngoscope **27**:422 (May) 1917.

6. Glasscheib: Avitaminosis as the Genesis of Ozena, Monatschr. f. Ohrenh. **65**:335 (April) 1931.

described the genesis of ozena as an avitaminosis that has a definite effect on the glands of internal secretion. He utilized an elaborate system for testing the functions of the individual glands, and reported that the anterior pituitary, thyroid, thymus, suprarenal and sex glands show a hypofunction, while the posterior pituitary has a hyperfunction. In his treatment he combined vitamin feedings with organotherapy and reported satisfactory results. However, in my experience the symptoms of ozena are alleviated by organotherapy only when a symptom complex that is definitely of an endocrine nature, such as certain types of dysmenorrhea, is associated with the ozena. These imbalances have not been proved to be specific in the genesis of atrophic rhinitis and often cannot be demonstrated at all. While a routine examination for ozena should include an investigation of the endocrine balance, glandular extracts should not be administered unless a definite imbalance can be demonstrated. Therapy of this type, based purely on hypothesis, not only is ineffective but may result in grave complications. I have observed a toxic goiter develop in a person who had been given thyroid feedings in one-half grain (32.4 mg.) doses, in combination with parathyroid extract and calcium lactate, for the treatment of hyperesthetic rhinitis. Prior to medication this patient had a normal basal metabolic rate and showed no signs or symptoms of hyperthyroidism.

In spite of the negative results in the animal experiments, diphtheria anatoxin-Ramon was used in a small series of cases of ozena. The Ramon preparation was used, as it is becoming the antigen of choice in both America and France for active immunization against diphtheria.[6a] Greengard [7] has reported uniformly good results, and the Dicks [8] found that they were able to immunize 94 per cent of susceptible persons with diphtheria toxoid using three doses, while five doses of toxin antitoxin immunized only 82 per cent. All of the patients treated for ozena showed a predominance of the pseudodiphtheritic bacillus of Belfanti in the nasal flora and had well advanced cases of atrophic rhinitis. Thorough physical examinations were made of all patients, and a sharp lookout was maintained for evidence of endocrine disturbances, although the elaborate tests described by Glasscheib were not attempted. Ovarian residue was added to the therapy in two cases in which there was a definite history of dysmenorrhea believed to be based on an endocrine disturbance. One cubic centimeter of commercial diphtheria toxoid was administered as an initial dose, but both the amount of the toxoid and

6a. Ramon, G., and Helie, G. I.: Diphtheria Prophylaxis in France, J. A. M. A. **91**:1028 (Oct. 6) 1928.

7. Greengard, Joseph: Diphtheria Toxoid (Diphtheria Anatoxin-Ramon) in Infancy, J. A. M. A. **97**:228 (July 25) 1931.

8. Dick, G. F., and Dick, G. H.: Immunization Against Diphtheria, J. A. M. A. **92**:1901 (June 8) 1929.

the frequency of its administration were pushed beyond the point described for the immunization against diphtheria, as many as twelve injections being given at five day intervals. However, in spite of the intensity of the therapy, the end-results were uniformly disappointing.

It is noteworthy to add that even after the pseudodiphtheritic bacillus disappeared from the nasal flora following the administration of toxoid, the crusting and odor persisted as surely as before.

CONCLUSIONS

1. Experimental atrophy cannot be produced in rabbits with the pseudodiphtheritic bacillus of Belfanti.

2. The pseudodiphtheritic bacillus of Belfanti is not specific in the etiology of ozena.

3. The rôle of endocrine dyscrasia in the genesis of ozena is questionable.

4. The administration of toxoid has no effect on the pathologic processes of ozena.

Clinical Notes

A USEFUL SELF-RETAINING ELECTRODE FOR ZINC IONIZATION IN CHRONIC SUPPURATIVE OTITIS MEDIA

MAX KIMBRIG, M.D., BROOKLYN

The treatment for chronic suppurative otitis media has often been discouraging and unsatisfactory. In spite of approved local treatment, the discharge does not clear up or it reappears with each new common cold or sore throat.

Levine[1] has said that one may distinguish three general classes of patients with chronically discharging ears: (1) those who should never be operated on, (2) those who should always be operated on and (3) those who should be operated on only after medical treatment has been given a fair trial.

Since the etiology of this chronic condition arises so variously, it is logical to study each case individually, eliminating as far as possible causative and aggravating factors. When grave exacerbation is evidenced by persistent vomiting, vertigo and nystagmus, these serious symptoms without a doubt call for operative procedure without delay.

In nonoperative cases I have personally had unusually favorable results, using ionization of the aural tissues with zinc sulphate. I consider this treatment of paramount importance in the permanent relief of chronic purulent otitis media and in the prevention of infective encroachment on the mastoid process. My experience agrees with that of Ballenger and Ballenger,[2] who said that the use of zinc ionization "seems to be of greatest value in cases of subacute or chronic otitis media with a central perforation."

In cases in which the ear has been running even as long as thirty or forty years, with chronic foul, profuse and thick discharge, I have found that within a few days after a single zinc ionization the discharge alters its character completely. From a putrid, heavy discharge, it becomes a scanty, thin mucoid secretion with no odor whatever.

This immediate control of the odor is one of the most arresting of the sequelae of ionization with zinc. The offensive odor usually clears up completely following a single treatment. After a few treatments the amount of discharge becomes practically negligible. Treatment, however, must be continued until the ear is completely dry.

A SELF-RETAINING AURAL IONIZATION ELECTRODE

The process of ionization with zinc requires the use of a zinc wire as a positive electrode, a solution of zinc sulphate and the galvanic current.

The electrode that I have devised for this purpose I have found to be especially suitable because of the simplicity of its construction and handling. It may be easily sterilized and is self-retaining, yet so flexible that it does not hamper the

Submitted for publication, Dec. 21, 1931.

1. Levine, M.: Practical Otology, Philadelphia, Lea & Febiger, 1927, p. 258.

2. Ballenger, W. L., and Ballenger, H. C.: Diseases of the Nose, Throat and Ear, Philadelphia, Lea & Febiger, 1930, p. 194.

movements of the head in restless patients, such as young children, who must so frequently be treated for running ears.

The accompanying diagram demonstrates the simplicity of this electrode. It consists of a glass tube, into which fits a zinc rod. The glass tube is of sufficient caliber to fit comfortably into the external auricular canal during the treatment. The zinc rod slides freely into the glass tube. A wire leads from the movable zinc rod to the positive pole. The indifferent electrode consists of a sponge soaked with a solution of table salt, held in the patient's hand, and is connected to the negative pole.

A direct current is necessary, and it may be derived from dry cells, a storage battery or a generator. It should be capable of delivering 10 ma.

METHOD OF IONIZATION

First the auditory canal must be carefully cleansed of pus by syringing with warm water. It is then wiped dry with cotton.

A solution of warmed zinc sulphate, 1 grain (64.8 mg.) to an ounce of water, is then syringed into the ear. At this point, satisfactory results require the removal of any air present in the middle ear by aspiration with an ear syringe. In the occasional case, the perforation in the drumhead may be too small to permit

A self-retaining aural ionization electrode. *G*, glass tube (1 by $\frac{3}{16}$ inch); *Z*, zinc rod (length, $\frac{15}{16}$ inch to hub); *S*, screw cap; *W*, wire to positive pole.

facile drainage of the zinc sulphate solution into the tympanic cavity. In this event, the solution should be injected by means of a small syringe through the hole in the drum.

The glass tube of the positive electrode is then fitted securely into the external meatus and the zinc rod inserted. The current is gradually turned on until a maximum of 3 ma. is reached. This should take approximately three or four minutes. I usually continue the treatment for from ten to fifteen minutes, and then diminish the current gradually. The auditory canal should not be dried after the treatment.

A reaction that sometimes draws the attention of one unaccustomed to using the method is a marked increase in the discharge after several treatments. However, this is but a temporary effect and should occasion no alarm. Other temporary side-effects of the treatment that I have infrequently encountered are a slight increase in aural pain, ringing in the ears, some vertigo and an occasional aural eczema, which, however, responds quickly to the usual local treatment.

CONCLUSIONS

Using electrolysis with zinc sulphate twice a week for a period varying from two to twelve or more weeks, I have had very good results in a considerable number of cases over a long period of time.

I consider the simple electrode that I utilize for this purpose as an unusually practical one for the following reasons:

1. It is simple in construction and use.
2. It can be used with ease in young children.
3. The two parts of the electrode may be sterilized by boiling.
4. Once treatment is commenced, the patient is comparatively free to move his head. The electrode fits snugly into the ear and cannot be dislodged easily.
5. The electrode insures the submergence of a considerable length of the zinc wire in the solution. Hence there is no possibility of interruption of the current, with its attending discomfort.

847 Lincoln Place.

IODINE POWDER IN THE TREATMENT FOR NASAL "CATARRH"

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Dusting iodine powder into the nose is an excellent remedy for drying up an excess of mucous discharge, if this discharge originates in the nasal mucous membrane. However, such secretions found in the nose are often in transit from one of the sinuses. Obviously in such cases any amount of medicine that requires direct application to a diseased part will be without results. This nasal "gleet" is often as annoying to the patient as the original pus, and patients complain bitterly that the discharge is just as bad as it was before the operation. If drainage and ventilation are well performed, in time, in the absence of irritation or infection, the excess mucus will eventually clear up, but this often takes years.

In some cases in which it was felt that the discharge was originating in the nasal mucosa and not collecting there on its way from the sinuses, repeated applications of iodine dusting powder had a very successful result. This stimulated a desire for some means of applying the powder into the diseased sinuses themselves. After making a naso-antral opening, it was found that the curved powder blower of Pilling could be forced under the inferior turbinate and out into the antrum. Then on compressing the bulb, the powder was deposited in the antrum. After a time it seemed that one puff did not deliver a sufficient amount of the powder, and with much awkwardness a second or third spoonful of powder was loaded into the instrument and puffed into the sinus. Removing and reintroducing the instrument was entirely too painful, as it is not my practice to amputate the end of the inferior turbinate. The results from such repeated treatments were much better. The objection was that the large instrument required painful force to wedge it between the inferior border of the inferior turbinate and the floor of the nose. This was sufficiently painful to require cocainization each time. The awkwardness of refilling has been mentioned.

On request, the deVilbiss Company prepared a long tube for their regular powder blower (*A*). This extension screws into the regular tip of the deVilbiss powder blower and tapers down at the end to the size of the smallest sized eustachian catheter. It is 2 inches long. With it, each individual part of the nose can be coated with the powder. Two of these are kept on the treatment tables. One is straight (*B*) for use in the nose, and the other curved (*C*) for use in the antrum. For the right or left antrum the tip is rotated with its curve concavity to the right or left. Due to its small size, this tip can be easily introduced under

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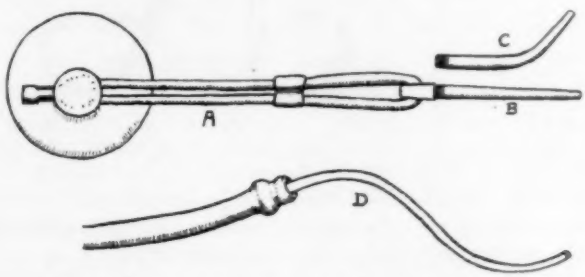
the inferior turbinate into the antrum without the use of cocaine. A continuous stream of the iodine powder is now delivered as long as air pressure is released. Soon after an opening has been made into an antrum, an easily recognized gurgling sound is heard as the powder-laden air enters the antrum. The tip is rotated forward and backward up and down so as to produce an even distribution of the powder. This air current has proved quite satisfactory for driving mucus from the sinus out into the nose, where it is easily removed by blowing. Recently it has been found advisable to insert a tube (*D*) and inflate the sinuses with plain air. If moisture is found (bubbling), an application of iodine powder is considered necessary. If the sinus is dry, no powder is indicated. This determination can be made with accuracy. Other forms of apparatus broadcast the powder, and little or none reaches the meati. Most of it lodges on the inferior surface of the middle turbinate.

A cautious light application can be made into the eustachian tube by inserting the long straight tip (*B*) into a eustachian catheter until it fits firmly and then releasing a little air pressure. I have seen no harm follow this, and in the case of moist tubes there is often a gratifying drying of the mucous membrane similar



Apparatus used for the administration of iodine powder in the nose and nasal sinuses: *A*, regulation deVilbiss powder blower; *B*, straight tip for depositing iodine powder in the meati; *C*, curved tip for depositing iodine powder in the right or left antrum, and *D*, cannula (diagnostic).

to that occurring in the nasal mucous membrane or the lining of the sinuses. The ordinary tip as supplied works best for depositing the powder in the infected middle ear.

Before the long tip was used, the sterilization of the powder blower was a problem. Water would enter the "nubbin" tip regularly supplied, form a paste and clog the apparatus. With the extension tip, this difficulty has not been encountered. For sterilization, the long metal tubes are inserted into the sterilizer just as for sterilizing an atomizer. On removal, the nurse gives the blower a rotary flip and this throws out any water that might have entered part of the straight tube.

In closing, a word on the preparation of the powder might not be misplaced. The druggist should dissolve the required amount of resublimed iodine in a small amount of ether. This is poured into a mortar containing a small amount of boric acid powder and rubbed well until the iodine has been evenly distributed in the boric acid. The powder prepared in this manner is not expensive and flows freely through a powder blower. In case the tube delivering the powder should become obstructed, the tip is small enough to be inserted into the air nozzle, and a reverse current of air quickly and completely clears the tube. A solution for irrigation is made by dissolving 1 drachm in a 4 ounce glass of water.

SUBMUCOUS FLAP PUNCH

ROBERT G. REAVES, M.D., KNOXVILLE, TENN.

This instrument was presented to the American Academy of Ophthalmology and Otolaryngology in 1930. It is designed to secure drainage and prevent hematoma following a submucus operation. It makes an oval punch hole which does not close as quickly as one made by knife and is much easier made. The punch straddles the flap, and three holes are usually made.

Submitted for publication, Dec. 14, 1931.

Progress in Otolaryngology

A Summary of the Bibliographic Material Available in the Field of Otolaryngology

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ANATOMY AND PHYSIOLOGY OF THE EAR

REVIEW OF THE LITERATURE FROM OCTOBER, 1930, TO OCTOBER, 1931

PHILIP E. MELTZER, M.D.

BOSTON

In presenting the review of the progress in the study of the anatomy and physiology of the ear, it is evident that all the available material has not been recorded. Many articles deserving of greater recognition than that afforded in this review have been omitted because of my own inability to review them creditably, and abstracts were in most instances not procurable. Interest in the subject continues to be lively. Recent experimentation on the cochlea by Wever and Bray at Princeton, Crowe and his co-workers at Johns Hopkins and Davis, Saul and co-workers at Harvard permits justifiable enthusiasm as to what these experiments may lead to in a practical way. The meritorious work by the European schools on the vestibular apparatus still forms the basis of the knowledge of this subject.

From a practical point of view it would seem that no great advance has been made in the past decade, particularly when one considers the tremendous amount of experimental work done. In other respects progress has been noticeable. Interest in the structure of the temporal bone from a histologic and anatomic standpoint has been changed in regard to the pneumatization process, as to both the mastoid structure and the petrous pyramid, notably by Wittmaack, Albrecht, Schwarz, Eagleton, Friesner, Kopetsky and Almour. Kobrak, Brunning and others have simplified and put the caloric test on a rational basis. Fisher has done a great deal to evaluate the vestibular tests. From an otologic standpoint the tests for the otolith organs still remain vague and doubtful. Encouraging reports and experimental data are being constantly gathered on the vasomotor influence on the functions of the ear. I think that otologists are approaching, though not rapidly, insight into the symptom complex known as Ménière's disease.

ANATOMY

Tanturri[1] corroborated what has been previously known of the anatomic pathways of infection extending from the middle ear to the cranial cavity, particularly those pathways passing along the perifascicular perineural tissue spaces. He used the term lymph channels rather freely and gave the impression that these tissue spaces form a part of the lymphatic system. The latest anatomic researches have failed to disclose a lymph system such as is found elsewhere in the human organism. The author's experiments indicated that there was a direct communication of the middle ear with the cranial contents as well as an indirect one by way of the labyrinth. A dye injected into the perineurium of the facial nerve appeared in the perifascicular tissue, which would seem to indicate that infection can extend to the posterior cranial fossa by way of the perineurium or lymph passages of the facial nerve. The same can be said of the perifascicular tissue spaces surrounding the small blood vessels which extend from the middle ear to the cranial cavity. India ink injected through the membrane of the fenestra rotunda was shown to have extended into the perilymphatic spaces, whereas the endolymphatic spaces and aqueduct of the cochlea are the route of transmission from the labyrinth to the cranial contents. This communication of the subarachnoid space with the perilymphatic spaces is well known and has been verified by many other investigators. Infection along the perineural spaces of the auditory nerve is important. I might say while on this subject that demonstrations of the pathways of infection by Crowe and Friesner, working independently, are the best that have been shown on this continent at least.

Kraus[2] examined roentgenologically 2,000 temporal bones, and described the pneumatization of the tip of the petrous pyramid. He used the term "Pyramidenspitze" in rather a wide sense. It was held to include all the parts of the petrous bone to the superior semicircular canal, that is, the region of the cochlea, internal auditory meatus, carotid canal, etc.

Pneumatization of the petrous pyramid takes place in two ways: 1. An extension of pneumatic cells from the epithympanic recess over the top of the superior canal. In some of the reproductions, air cells between the upper margin of the superior semicircular canal and the sharp line marking the upper border of the petrous bone showed very well.

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1. Tanturri, D.: Monatschr. f. Ohrenh. **64**:1005 (Sept.) 1930; abstr., Arch. Otolaryng. **13**:288 (Feb.) 1931.

2. Kraus, L.: Arch. f. Ohrenh-, Nasen- u. Kehlkopfh. **127**:307, 1931; abstr., J. Laryng. & Otol. **46**:501, 1931.

2. An extension from the hypotympanic and peritubal air cells which reach the pyramid from the region below the labyrinthine capsule. Pneumatization of the pyramid runs parallel with pneumatization of the mastoid cells, but is necessarily less frequent, as it represents a more advanced stage of this development. Approximately half of the bones showing well formed air cells in the mastoid also show some air cells in the "tip" of the petrous pyramid. Taking all the temporal bones together, approximately one-fourth show pneumatization of this deeper region.

Turkewitsch [3] summarized the results of his study of the anatomic structure of the human bony labyrinth in relation to age and sex. His findings were as follows:

1. The length of the vestibulum does not change after two and a half years, and in the course of later life may increase in length by from 0.2 to 0.3 mm.

2. The width of the auricle ceases to grow after the fifth month.

3. The height of the auricle is not subject to changes depending on sex.

4. The auricle becomes flatter with age.

5. The auricular walls become thicker with age and then fuse with the compact substance of the pyramid of the temporal bone.

6. The auricular fenestra does not change with age.

7. In males the auricle is larger than in females.

8. The dimensions of the auricular fenestra are the same in both sexes.

9. The semicircular canals do not increase with age.

10. In males the semicircular canals, ampullae and crus commune are longer than in females.

11. The transverse section of the semicircular canals become more round with age.

12. The S-shaped curvature of the semicircular canals is well pronounced in fetuses and new-born infants.

13. The relation of the planes in which the semicircular canals form the S-shaped curvature does not change with age and sex.

14. The cochlea becomes higher with age, and the width of the base of the first convolution becomes larger.

15. The form and size of the auricular fenestra are varied, but do not depend on age or sex.

16. In females the cochlea is higher and the base of the first convolution is wider.

3. Turkewitsch, B. G.: Anat. Anz. **70**:225, 1930.

Girard,[4] on the basis of considerable study and reasonable argumentation, explained his view to the effect that the natural horizontal plane of the skull rests on the plane of the horizontal semicircular canal. The so-called Broca's plane, which corresponds to the attitude of the head on looking toward the horizon with the eyes in the primary position, cannot be utilized because, aside from other reasons, it is not applicable to animals. Also the so-called Francfort plane was rejected by the author. He convincingly showed, in illustrations of the skulls of camels, tame cattle and bison, that the normal posture of the heads of these ruminants actually corresponds to his contention. The plane of the external semicircular canal seems to indicate generally the horizontal plane for the natural posture of the head in animals and birds, for the author could find no exception to this rule in over thirty species of mammals and twenty species of birds. He proceeded to explain that the same is likewise true for man. It is the posture of the head of a walking person who contemplates the ground two or three steps ahead of him, and is the posture in reading, writing, manual work, etc.

The plane of the horizontal semicircular canal can be externally ascertained in man by drawing a line from the intersection between the helix and the anthelix; on the other hand, the upper border of the orbital margin constitutes a convenient landmark. In a general way it constitutes a good medium landmark among the human races. By means of these two landmarks, any one may study the vestibular plane and compare it with the plane of horizontal vision. The latter may perhaps appear more esthetic, or "military," as the case may be, but hidden behind it will be found the true normal physiologic original posture of the head, as assumed by man when he bends over his work or contemplates the ground he is going to tread with his feet.

HISTOLOGY AND EMBRYOLOGY

Recent research by Guild, Crowe, Bunch and Polvogt [5] is based on the histologic examination of about 1,200 temporal bones, for about one third of which there were records of the condition of hearing during life. Fifteen of the cases were selected for detailed examination. From these, graphic records were made on standard skeleton diagrams showing (1) the approximate total number of ganglion cells in the spiral ganglion and (2) the average number of ganglion cells per millimeter of length of Corti's organ at various levels of the cochlea.

4. Girard, L.: Oto-rhino-laryng. internat. **14**:517 (Nov.) 1930.

5. Guild, S. R.; Crowe, S. J.; Bunch, C. C., and Polvogt, L. M.: Acta oto-laryng. **15**:269, 1931; abstr., J. Laryng. & Otol. **46**:508, 1931.

The total number of ganglion cells was found to range from 23,200 to 27,800 in young adults. The number in children was greater, averaging 29,000. The figures for each region of the cochlea were: lower basal, 934; upper basal 1,076; lower middle, 973, and upper middle plus apical, 502. Thus the density of distribution of ganglion cells at various levels of the cochlea corresponds roughly with the fineness of sound perception at the various levels of the tone scale, as measured by the audiometer, on the supposition that high tones are relegated to the basal and low tones to the apical end.

In ears in which there has been loss of hearing especially affecting the high pitched tones, the total number of ganglion cells was found to be diminished, the deficiency being about twice as great in the basal as in either of the other regions.

In one case of severe deafness the number of ganglion cells was reduced to 4,437. On the other hand, when the deafness was of the middle ear type, the deficiency in the ganglion cells was not so marked as in cases showing the same degree of deafness of the degenerative type.

A correlation of the ganglion cell count and the loss of hearing for different tones in a number of cases points to the following conclusions: Tones above 3,000 double vibrations affect the upper basal coil and parts above it; tones of 4,000 or more double vibrations affect the lower basal turn. In greater detail the following are the limits: circa 4,096 double vibration, the upper end of the lower basal coil (8 or 9 mm. from the extreme base); circa 8,192 double vibrations, the middle and lower basal coil (5 mm. from the basal extremity); above 8,192 double vibrations, the lower fourth of the basal coil.

These results may be compared with those obtained in the classic experiments of Wittmaack and Yoshii on the degenerations produced in the cochlea by prolonged tonal stimulation, which they strikingly confirm and extend. In both investigations the indications obtained are much clearer for higher tones and the basal coil of the cochlea than for the rest of the scale, but in spite of this limitation, they concur in pointing to the existence of a series of pitch levels in the cochlea.

Schwarz,[6] who has contributed several illuminating articles on the pneumatization of the mastoid process, thought that a hereditary factor exists. According to this more recent article he examined the bones of many new-born infants and human fetuses, and was definitely of the opinion that the constitutional factor plays an important part. He described the changes in the middle ear cavity and the results of examination of the subepithelial connective tissue. Schwarz maintained that

6. Schwarz, H.: Arch. f. Ohren-, Nasen- u. Kehlkopfh. **129**:1 (June) 1931; abstr., Arch. Otolaryng. **14**:512 (Oct.) 1931.

the subepithelial connective tissue plays a rôle in the pneumatization which is perhaps as important as the part played by the epithelial tissue. When the connective tissue remains embryonic in type, pneumatization is inclined to be deficient. In specimens in which pneumatization is good, the subepithelial tissue has well formed fibroblasts which resemble adult fibrous tissue.

Belonoschkin [7] stated that the formation and development of otoliths are an inorganic process, similar to the formation of calculi in the animal body. Otoliths are stone concrements. The vital factor in this is merely the excretion of the colloid secretion of the sensory epithelium, which represents a gelatin. In it, the inorganic calcium salts become concentrated and then precipitate as crystals. The concentration occurs by absorption and, in part perhaps, also by chemical combination. The endolymph cannot hold the salts of otoliths in simple aqueous solution, first of all, because its quantity is insufficient, as it has an alkaline reaction and contains almost no (protective) colloids (0.01 per cent albumin). Secondly, this could not be possible on the basis of Donnan's membrane equilibrium between blood and endolymph. The gelatin, as a well differentiated formation which is present only in definite places (the maculae lagenae, sacculi et utriculi) in vivo, is preformed even before the precipitation of the otoliths. Such formations can be observed as early as the sixth day. On the seventh day, the day of the precipitation of the otoliths, one may also observe the sensory fibrils, so that the assertion of Herzog and Nichio that the fibrils appear much later and have no relation to the macularium formation is not tenable. The relations between the gel of the macularium and the sensory epithelium are not merely apparent ones. They are firmly and intimately connected with each other. Not only the entire process of the development but also the observations on grown animals indicate this. This connection is due to embryologic factors. The crumbly and filiform formations within the labyrinths have nothing in common with the macularium and with the otoliths. Thus, the processes of the development of the otoliths may be traced without constraint to the colloid chemical and physicochemical laws.

PHYSIOLOGY OF THE COCHLEA

Alexander [8] gave an excellent critical review of the literature and also his own impressions in regard to the physiology of the ear. His summary was: In all vertebrates that are provided with an air-containing

7. Belonoschkin, B.: Arch. f. Ohren-, Nasen- u. Kehlkopfh. **128**:208, 1931.

8. Alexander, G.: Monatschr. f. Ohrenh. **65**:1 (Jan.) 1931; 173 (Feb.) 1931: abstr., J. Laryng. & Otol. **46**:501, 1931.

eustachian tube, closed outwardly in the condition of rest, a differentiation must be made between the ossiculocochlear and the aerocochlear conduction of sound.

The ossiculocochlear route leads from the tympanic membrane through the ossicular chain, the oval window, the scala vestibuli and the helicotrema to the scala tympani.

The aerocochlear route leads from the tympanic membrane via the air of the tympanum through the round window direct to the scala tympani. The physiologic acoustic stimulus is produced by vibrations of the basilar membrane in accordance with the anatomic structure of the cochlea. These vibrations cause an alteration of position of the hair cells and are then converted into a sensory stimulation of the terminal ends of these cells.

In the condition of rest the terminal ends of the hair cells lie in contact with the under aspect of the membrana tectoria.

The positions of the very mobile, though not elastic, membrana vestibularis and membrana tectoria permit only an extremely limited conduction of sound from the scala vestibuli to Corti's organ, and it is only a portion of the lower tones that can be thus transmitted.

Thus aerocochlear conduction offers a direct route, especially for the high tones, the stimulus of which can be carried to the end-organs without loss of intensity.

The vibrations of the lower tones are also possibly conducted by the perilymph around the oval window via the scala vestibuli and helicotrema to the scala tympani and there assert themselves as a physiologic stimulation of the basilar membrane.

In the normal ear of man, when the tube is closed, ossiculocochlear conduction and aerocochlear conduction of sound function together. But, while the ossiculocochlear route is of supreme physiologic importance, the aerocochlear route constitutes the principal or only method of conduction of the higher tones.

The membrane of the round window can function only, for the aerocochlear route, when the intracochlear pressure is not raised, and the latter can be controlled by the condition in the aqua cochleae; the internal auditory meatus similarly subserves the conduction of sound by the ossiculocochlear route.

The cochlea and labyrinth are combined anatomically in one organ, because they both control orientation and both respond physiologically to the movement of the fluid contained in the internal ear. The stimulus of the labyrinth is the result of an active or passive movement of the head or of the whole body causing movement of the endolymph. The cochlea is a perilymphatic organ; the labyrinth, an endolymphatic organ.

The necessary resilience for the functioning of the acoustic vibrations of the perilymph is provided in the aqua cochleae and the lymphatic system, and the resilience for the labyrinthine movements is provided by the canalis reuniens and ductus endolymphaticus, conflict between the two functions being controlled by the perilymphatic septums in the vestibule.

In the normal human ear the tube is closed during rest, thus preventing influence on both sides of the tympanic membrane, which would result only in a slight movement. Thus, too, a disturbing autophony is obviated, and the tympanic membrane is unaffected by the respiratory movements.

The early appearance of deafness as the result of tumors of the eighth nerve is rendered intelligible by this physiologic relationship between the aqua cochleae, internal auditory meatus and the route of sound conduction.

In the normal human ear the aerocochlear route is important for the conduction of the higher but not for the remaining tones.

The knowledge of sound direction, i. e., orientation by means of sound, is dependent on the ossiculocochlear conduction of sound, but analysis of this sensation is ultimately a cerebral function.

Ossiculocochlear conduction and aerocochlear conduction act together in the human ear, the former being most active in normal ears when the tube is closed. Under pathologic conditions, especially when the tympanic membrane, ossicular chain or both are destroyed, the aerocochlear route is the principal route. It is only for the lower tones up to about 90 double vibrations that the ossiculocochlear route is absolutely necessary.

When the tube is open or, in the normal ear, at least at the moment of opening, the lower tones, with the exception of the very lowest, are conducted by the aerocochlear route.

The two windows can both act as receptors of sound or corresponding resilience agents, but not simultaneously.

Pathologic closure of both windows, even if the cochlea is intact, leads to a marked loss of hearing, while if the cochlea also is only slightly diseased absolute deafness results.

Sound conduction in the vertebrates varies; with a decrease in the development of the ossicular chain and an increase in the size of the round window, aerocochlear conduction becomes of greater importance.

With the increase of the tympanic bulla the opening of the round window into the bulla also increases, and the increase of the tympanic bulla may be taken as indicating also an increase of the aerocochlear route of sound conduction. This condition is highly developed in the cat, in which the middle ear is almost completely divided into two

parts; the lower portion is represented by the bulla and the round window, and the upper and posterior part contains the ossicular chain.

The bulla and round window are most highly developed in those animals which react most strongly to high tones and especially in those species which rely for orientation more on the ears than on the eyes and nose.

Great caution, however, must be observed in regard to the facts of comparative anatomy as necessarily applicable to man, and many of the arguments in the literature on this subject are therefore unreliable. The actions of the "artificial tympanic membrane" can be explained, according to one's inclination, as evidence of either ossiculocochlear or aerocochlear conduction of sound.

In man it is possible to conceive of pathologic changes in the middle ear that may lead simultaneously to impairment of the ossiculocochlear and improvement of aerocochlear conduction.

All otologists, perhaps, will be unable to accept unreservedly Alexander's conclusions in toto, but all will at once admit the vast amount of knowledge of the subject that such an effort must have entailed and the considerable selective skill necessitated in compressing the matter into some fifty pages; all, too, will unite in congratulating the author and thanking him for this presentation of current opinion on a most intriguing problem of otology which is still *sub judice*.

Bonain [9] discussed vibrations and vibratory waves as well as auditory membranes and tissues. The question whether there are acoustic progressive vibrations and vibratory waves can hardly be answered in the affirmative. There are three distinct manifestations of vibratory energy in the acoustic organ: (1) acoustic or sonorous vibrations; (2) progressive vibration waves or acoustic waves, which transmit various modalities of vibrations; (3) stationary waves, i. e., the "fixed waves" of older authors; they are really secondary vibrations produced by the interference of reflected progressive waves with direct waves following them. Sonorous vibrations develop in elastic bodies; a more or less considerable number of molecules is displaced at the same time from the position of equilibrium. They have a limited amplitude and vary frequently; they are produced in a solid body vibrating in the air; therefore a layer of air more or less thick is engaged in the movement. The vibration energy is transmitted to the adjoining molecules. This energy progresses from molecule to molecule. This transport of vibration energy has been given the name of progressive wave or vibratory wave. The sound is propagated by its action. Vibrations are born and they die in the same place; only a progressive wave travels. Acoustic waves or progressive vibratory waves do not have elevations and depres-

9. Bonain, A.: Arch. internat. de laryng. **9**:769 (July-Aug.) 1930.

sions like vibrations. An acoustic wave may be diffused, refracted, reflected, filtered and subjected to interferences. Only a progressive wave is able to engage a stationary wave in a secondary vibration. It is evident that vibratory waves are two entirely different phenomena. The terms, molar and molecular vibrations, are used by some authors. A molar vibration is a movement of a group of molecules.

The movements of the bones of the internal ear and the vibrations of the membrana tympani are not vibratory movements but movements of each bone, i. e., molar movements. The existence of stationary waves is a recognized fact. These waves are really secondary vibrations reproducing primary vibrations of the vibrating body; they develop in short or long canals, opened or closed at the ends. Theoretically, a membrane is a solid layer infinitely thin and flexible, subject to a tension; the concave part of the drum on the external side cannot vibrate with a great frequency, that is, there cannot be over 480 vibrations. A membrane does not necessarily vibrate under the action of acoustic waves hitting it; it may permit the acoustic waves to pass through without vibrating, but it is known that propagation of sound through solid mediums, liquids or gases is accomplished by progressive waves. Reproduction and transmission of sound are two entirely different phenomena. The membrane extended on a ring vibrates at the level of the depression of the stationary waves, but it stops vibrating at the level of the elevation. Certain investigators attribute vibrations of a membrane to vibratory movements of the air at the level of the depression of stationary waves. Certain conditions are necessary for production of vibrations in membranes under the influence of progressive acoustic waves: 1. The membrane must receive the wave from a right angle. 2. The mechanical energy of the waves must be sufficient to depress the membrane and to mobilize it; otherwise the membrane does not vibrate, but allows the progressive vibratory waves to penetrate it; sounds are propagated through such waves. The mechanical action of stationary waves is reenforced by a cylinder placed in front of the membrane; such a canal concentrates the waves. A lens is formed by the space between the membrane of the fenestra rotunda and the posterior segment of the drum. The refraction of a progressive wave does not depend on the length of the waves; it depends on the refraction index of the medium. This index is determined by the acoustic density of the medium; it is in a reverse proportion to the velocity of the propagation of the sound in this medium. The auditive accommodation by refraction of converging and diverging acoustic waves corresponds to variations of the curvature of the tympanic gaseous length; it has some analogy to refraction of luminous waves by a lens changing its curvature by visual accommodation. But in auditive accom-

modation it is not necessary to establish a focus or an image of acoustic waves; it is necessary only to facilitate the access of the waves to the drum. This hypothesis is subject to discussion because one does not know the index or refraction of the gaseous lengths of the tympanic box. It is probable that the air in the cavum tympani and in the mastoid cells is richer in carbon dioxide than the external air; the velocity of propagation of sounds in carbon dioxide is 270 meters, as against 340 meters in air containing 15 per cent carbon dioxide; the temperature of the air in the tympanum is about 30 degrees. Hence one is entitled to believe that the index is slightly higher than that of the atmospheric air and that the acoustic waves may be refracted in convergence. The convergence or divergence of acoustic waves depends on the curvature of the surface of this lens. Changes of the shape of this lens are an established fact; they are due to the action of two muscles of the chain of bones. Both membranes, that of the round window and that of the posterior segment of the drum, may become convex or concave simultaneously or one after the other. Variations of the pressure of the perilymph must be taken into consideration. An excess of pressure diminishes the sensibility of the membraneous resonators of the internal ear and vice versa. The pressure of the bones of the internal ear on the perilymph is a means of protection of the organs of the labyrinth against too strong acoustic waves; the only objection to the application of such pressure to the auditive accommodation is the fact that pressure by one of these two fenestrae on the perilymph is compensated by a depression of the same strength at the level of the other fenestra.

The second article by Bonain,[10] which is a comparative study of the functional rôle of the labyrinthine organs, is interesting. It has been satisfactorily proved that the functions of the vestibular organs have no relation to the transmission of the vibration waves or acoustic waves, but depend entirely on the displacement of otoliths by the motions of the head or the entire body. In other words, the vestibular organs are the organs of a static and kinetic equilibrium. In a series of animals the labyrinth consists of an otocyst or an apparatus comprising otoliths and ciliated cells; it is an organ of static equilibrium. A membrane corresponds to the fenestra ovalis of higher animals. This membrane must be regarded as a protection of the otocyst. Certain reptiles which do not possess a middle ear have a supplementary bone, the so-called columella, which links the operculum of the fenestra ovalis with temporal muscles. Owing to this fact, these muscles may act on the otocystic perilymph and diminish the action of too strong waves. In higher vertebrates this protective apparatus is more nearly perfect. A middle ear appears with a round fenestra permitting access to acoustic waves;

10. Bonain, A.: Arch. internat. de laryng. **9**:783 (July-Aug.) 1930.

a drum appears. Numerous articulated bones appear in the middle ear, making the protective mechanism more flexible. Muscles acting on this apparatus permit a graduation of its action; the mechanical energy is in proportion to vibration waves. In certain cetaceae the middle ear is isolated from the external fluid by the wall of the skull; on the way to sensory auditive elements the acoustic waves encounter considerable resistance. These various developments of the apparatus of equilibrium and audition in the phylogenetic order of various species prove that the fenestra ovalis, the membrana tympani and the chain of bones are interposed for the protection of the organs of the labyrinth and for auditive accommodation; it is also shown that the fenestra rotunda, a more direct and permeable path for acoustic waves to the sensory auditive elements, has the function of transmitting the sounds to the internal ear. Anatomy, clinical observations, pathologic anatomy, experiments and the acoustic organ itself corroborate these statements; they show that it is useless and even dangerous to transmit sounds through the fenestra ovalis and the vestibule. Obstruction of the fenestra rotunda leads to a great interference with hearing; sufficient hearing is preserved if the drum and the bones of the internal ear are absent.

Bouman [11] summarized an extensive investigation. The title of his article is "Broca's Phenomenon in Association with the Theory of the Inner Ear," this phenomenon being as follows: When the experimental subject is permitted to listen at the same time to two sounds of similar frequency but different intensity, he obtains the impression that the height of the two sounds is different.

Broca stated further that the persons tested conceived the louder sound as deeper than the lower one of similar frequency; Bouman's conclusions are:

1. The analysis of a complex sound is a peripheral phenomenon.

2. Experiments with sounds of a constant frequency, practically free from overtones, have shown that the phenomenon first described by Broca—the dependence of the subjective tone height on the intensity of the sound—actually exists.

3. Broca's phenomenon is less pronounced in deeper sounds than in higher sounds.

4. Broca's phenomenon can be explained according to the resonance theory of Helmholtz, by the following two hypotheses: The resonators situated in the maximally oscillating resonator may influence the subjectively heard tone height, and the oscillations of the basilar membrane when the latter is stimulated by air are not symmetrical but asymmetric.

11. Bouman, H. D.: Arch. néerl. de physiol. **15**:311, 1930.

5. The subjective tone height of the heard sound increases when the strong sound of a lower frequency is added and decreases when a strong sound of somewhat higher frequency is added.

6. The phenomenon given in 5 is based not on an interference phenomenon of the basilar membrane but is an expression of fatigue of the nerve elements belonging to the resonators.

7. The phenomenon given in 5 supports the first hypothesis given in 4.

8. In bone conduction from the mastoid process, Broca's phenomenon disappears completely or almost completely. This factor supports the second hypothesis given in 4.

9. The resonance theory is better able to explain the experimental data on Broca's phenomenon than the theory of Ewald.

10. Among the 112 persons examined, only 2 were found in whom Broca's phenomenon did not disappear during bone conduction extending from the mastoid process.

11. The tone limits given by Bouman and Kucharski must be considered as a measure of the propagation velocity in the basilar membrane.

12. In the two exceptional cases mentioned, there apparently was a slowed conduction through the basilar membrane.

13. It is reasonable to assume that the inner ear contains, besides the resonator system of the basilar membrane fibers, another resonator system which is more closely related to the sensory cells than the fibers of the basilar membrane. This system is probably found in the organ of Corti.

In reference to the technic used in the experiments, it may be stated that the sound was produced by means of an electron-tube generator. Phonograms of the sounds produced have shown definitely that the latter were practically free from overtones.

Leiri [12] first directed attention to his former publications on the perception of ultramusical tones, in which he expressed the opinion that ultramusical tones as well as the nonperiodic oscillations of noises are transmitted to the auditory cells by oscillations of the basilar fibers. Some investigators have questioned the possibility of oscillations of the basilar fibers, because they are embedded in a layer of tissue. However, the author showed that the fact that the basilar fibers are embedded in the membrana basilaris does not inhibit their oscillations but rather facilitates them for sounds the oscillatory frequency of which is close to that of the fibers.

12. Leiri, F.: Arch. f. Ohren-, Nasen- u. Kehlkopfh. **128**:12 (Feb. 12) 1931; abstr., Arch. Otolaryng. **13**:749 (May) 1931.

Wittmaack [13] showed how the variations of the fluid in the labyrinth are transmitted to the organ of Corti or to the auditory nerve. He first discussed the structure of Corti's organ, particularly Corti's membrane and its relation to Corti's organ. He was convinced that Corti's membrane does not float free above Corti's organ but is directly connected with it, and that the two together form one apparatus which in all directions is shut off against the endolymph space of the ductus cochlearis. Thus the liquor spaces within this apparatus are not in free communication with the liquor of the ductus cochlearis. There are indications that Corti's membrane has a certain degree of turgescence. This turgescence must be maintained against the pressure of the endolymph in the ductus cochlearis. The equilibrium between the two pressures is the biologic foundation for the estimation of the stimulation process. Fluctuations in the tonus of the organ of Corti alone do not produce stimulation. However, it may be assumed that in the cochlear apparatus physically produced pressures that are not dependent on the tonus may effect stimulation, similar to the conditions in the vestibular apparatus. Wittmaack believes that, owing to influences that are exerted on the hair cells, the stimulation process in Corti's organ is no longer tenable. He thinks that the specific sense of perception cannot be due to shifting or bending of the hair cells, but rather it is based on the capacity to perceive minute differences in pressure that have been transmitted by hydrostatic means. The essential difference between the vestibular and cochlear conditions is that for the stimulation of the sensory terminations of the vestibule one or several pressure fluctuations that follow each other after longer intervals are adequate, whereas the adequate stimulation for the organ of Corti consists in rhythmic, short, internal fluctuations in pressure. That in the course of phylogenetic development the separation of the organ of Corti from the complex of sensory terminations of the vestibular apparatus was due to the fact that the organ of Corti had a new functional task for which the sensory terminations of the vestibular apparatus were not equipped, has been generally accepted as the foundation for the ideas about the function of the vestibular, as well as of the cochlear, apparatus. Wittmaack further discussed the biologic foundations of the process of stimulation and then the stimulation process in relation to the theories of sound perception. He thought that his observations corroborated the Helmholtz theory.

Friedmann [14] stated that the fundamental difference between his new theory of sound perception and the generally accepted theory of

13. Wittmaack, K.: Arch. f. Ohren-, Nasen- u. Kehlkopfh. **129**:118 (June 26) 1931; abstr., Arch. Otolaryng. **14**:514 (Oct.) 1931.

14. Friedmann, W. L.: Monatschr. f. Ohrenh. **64**:1468 (Dec.) 1930; **65**:313 (March) 1931; abstr., Arch. Otolaryng. **13**:753 (May) 1931.

Helmholtz is that he ascribed the main rôle in the conduction of sound toward the ends of the auditory nerves to the molecules of the hidden gases that are dissolved in the labyrinthine fluid of the cochlea and that are also present in the other tissues (bones and blood) on the track to the labyrinth. It is known that at a temperature of 0 C. (32 F.) and under pressure of 760 mm., 60 cc. of gases may be extracted from 100 cc. of blood. These gases consist of oxygen, nitrogen and carbon dioxide, and they are present in all the tissues of one's organism. Their pressure is equal to the atmospheric pressure. Friedmann stated that he arrived at his new theory of sound perception on the basis of the latest observations on the physiology and pathology of the hearing process, which cannot be explained by Helmholtz' theory, for instance, the unusual susceptibility of the ear to the different sounds. The maximum susceptibility is for sounds with approximately 2,300 vibrations, whereas sounds with a low frequency of about 100 vibrations cannot be differentiated. Another observation, which cannot be explained by the older theory of the rôle of the sound conduction apparatus, is that high sounds do not require the mediation of the tympanic membrane and of the auditory ossicles, for in chronic diseases of the middle ear the susceptibility for high sounds is only slightly impaired. As to the reason why the ear is most susceptible to sounds with a frequency of about 2,300, Friedmann assumed that this frequency is close to that of the molecules of gas in the cochlea, and he also thought that the specific adequate stimulation of the terminations of the auditory nerve in Corti's organ is the vibrations of the molecules of gas in the labyrinthine fluid. He considered tinnitus aurium the result of a disturbance in the equilibrium between the molecules of gas in the blood and those in the tissues. The fact that tinnitus aurium generally corresponds to high sounds is in accordance with the assumption that the vibrations in the cochlea are within the region of the higher sounds. The author asserted that his theory does not contradict the well known fact that the majority of sounds cause vibrations of the tympanic membrane and of the auditory ossicles. However, he thought that these vibrations of the sound conduction apparatus cannot be visualized without the simultaneous vibrations of the molecules of gas. He comes to the conclusion that the sound conduction apparatus is of significance only for the acuity of hearing or for the quantity capacity and only for low sounds. He considered the molecular vibration of the gases in the cochlea as the essential and absolutely necessary element of the act of hearing. He pointed out that otologists have long been aware of the fact that the conduction apparatus plays only a secondary rôle in the act of hearing, for if they are consulted by a patient who is not able to understand even loud talking, they know before examination that the disturbance affects the nervous apparatus.

Denker [15] reviewed the recent work on the sense of hearing in fish. The conclusions arrived at may be summarized as follows:

1. Compensatory vertical deviation of the eyes does not depend on the saccule.

2. After extirpation of the saccule, equilibrium is not affected either at rest or in motion.

3. After total extirpation of the labyrinth on one side, rotation around the long axis occurs toward the side operated on. Von Frisch has had a series of films prepared illustrating these reactions.

H. Stetter has carried these observations even further. The upper tone limit varies in different species and individuals: in minnows from d^5 to g^5; in loach, from c^4 to g^4, and in shad, over g^6; the lower tone limit in a minnow is C_{-11} (-1^6 double vibration per second).

This fineness of perception in minnows and shad for tone in the middle scale is not much less than in man. The smallest tone interval that Stetter could educate a minnow to distinguish was a minor third. Denker repeated some of these experiments. He was unable to establish any reaction to sound in rainbow trout or perch, but succeeded readily with goldfish and minnows. Denker commented on the fact that, under ordinary conditions, sound is apparently not a stimulus of biologic value to fish, and he regarded the faculty of "hearing" as latent and requiring to be elicited by education. If this be so, the education of certain species of fish by means of "association building" is remarkably rapid.

PHYSIOLOGY OF THE MIDDLE EAR

Luscher [16] has written considerable on the reflex movements of the membrana tympani and structures of the middle ear. In this article he stated that in human beings reflex movements of the drum may be observed only exceptionally; they may be caused by acoustic or sensitive stimuli; in rare cases spontaneous movements of the drum occur; the reflexes are always bilateral and are therefore undoubtedly consensory. Only retractions, never protrusions, are observed. These movements are probably caused by contraction of the tensor tympani, but this cannot be directly proved. Such reflexes are observed only in abnormally sensitive and therefore abnormally reacting persons; a contraction of the tensor caused by the will of the patient is also abnormal. It is possible that there are only quantitative differences between such patients and normal persons and that such movements represent an exaggerated picture of a normal function, but it is possible that there are also qualitative differences.

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15. Denker: Acta oto-laryng. **15**:247, 1931; abstr., J. Laryng. & Otol. **46**:569, 1931.

16. Luscher, E.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **28**:40 (Dec.) 1930.

Luscher did not feel justified in making a definite hypothesis applicable to the normal physiologic action of the tensor muscle. Examination with the aural microscope is important for such an observation. He could not come to any positive conclusion regarding the normal physiologic action of the tensor tympani.

One is justified in assuming that a normal physiologic contraction of the tensor tympani is too weak to cause a movement of the drum noticeable with the aural microscope. This fact is regrettable because the method does not allow one to study the action of the tensor tympani muscle on the intact drum in normal and pathologic cases. Luscher used a microscope which produced an enlargement of from ten to twenty times. Movements as small as from 0.05 to 0.025 mm. can thus be recognized. Acoustic stimuli, such as whistling or the sound of a siren, were used in experiments on fifty persons with normal ears; a reflex movement of the drum was observed only in 1 person, but the movements were constant. The drum was displaced by pressure in the external auditory canal or by aspiration; such a drum did not respond to acoustic stimuli with reflex movements. Two patients were observed who had facial paralysis; in these patients the antagonistic action of the stapedius muscle was excluded; no reflex movements of the drum could be obtained. The amplitude of the movements of the drum caused by pressure or aspiration was not influenced by acoustic stimuli. Pressure or aspiration in the opposite auditory canal—in other wards, a change of the balance of the auditory bones—was not followed by reflex movements of the drum. If the drum was displaced by a constant aspiration, it remained in a new position as long as the aspiration lasted, as long as five minutes. It appears that active contractions of the tensor tympani do not occur under such conditions.

Among the fifty persons examined, a constantly appearing reflex could be observed in one; this reflex was caused by the touching of both auditory canals. Closing of the jaws, yawning, swallowing and the production of vocals had no visible influence on the movements of the drum. It follows that apparently there is no concomitant movement of the drum when the trigeminus or glossopharyngeal nerves are stimulated. Movements of the drum caused by a normal physiologic action of the tensor tympani must lie below the point of visibility if an enlargement of from ten to twenty times is used.

Gyergyay[17] reported his experiments on the function of the eustachian tube. He stated that in swallowing, the tube goes through the following stages: (1) repose, (2) preparation, (3) the middle stage of full action, (4) final stage and (5) repose. There are two types of

17. Gyergyay, V.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **27**:408, 1930; abstr., J. Laryng. & Otol. **46**:780, 1931.

the third stage. In the first the tube closes more firmly than in the stage of repose. In the second type it opens more widely than in respose. Gyergyay called the first the Politzer type and the second the Lucae type. salpingoscopy in the first type the levator cushion is seen to rise suddenly; then the soft palate rises, the levator and the superior constrictor move forward and downward and the side wall of the tube sinks inward, forming the dilatation-depression between the levator and tensor while, lastly, the levator and the constrictor relax and reunite the nasal and pharyngeal cavities.

THE OTOLITHIC APPARATUS

The function of the otolithic apparatus has been reported several times in this review but a recent article by Despons [18] is, in my opinion, worthy of a detailed report.

Recent anatomic studies have shown that the nerve fibers of the otolithic passages pass through the vestibular nerve. If these findings are not accepted, it is necessary from a physiologic point of view to consider that the otolithic apparatus has a true function which must be distinct from that of the semicircular canals.

These anatomic investigations are still in the experimental stage, but it is no less true that the findings should not be ignored.

The membranous vestibule includes the utricle, with the mouths of the membranous semicircular canals, and the saccule which is in communication with the utricle and the canal of the cochlea. The otolithic organs are situated in the utricle and saccule. However, these organs have a different arrangement. The utricular apparatus is arranged in the frontal plane while the saccular organ is situated in a plane that is intermediary to the frontal and sagittal planes. The otolithic apparatus is especially concerned with static equilibrium while it is known that the semicircular canals are involved in kinetic equilibrium. Hence the rôle of the otolithic function must be studied in different attitudes.

The utricular organs originate the reflexes produced in the sagittal plane. The saccular organs originate the reflexes in the frontal plane.

It is generally considered that these reflexes are due to the action of weight. According to Magnus this action is produced by traction of the otoliths on the cilia. Quix, on the contrary, considered that the otoliths act by pressure.

Thus it can be realized that whatever the mechanism is, the stimulation of the otolithic system is produced by movements of the head. This stimulation originates reflexes that are concerned in positions of attitude. It remains only to determine the position of the head that correspond to the stimulation of one or the other of these otolithic

18. Despons, J.: J. de méd. de Bordeaux **108**:163 (Feb. 28) 1931.

organs. There are some tests that can be used to examine the utricular and also the saccular function.

It should be remembered that the utricular function is concerned in movements of extension and flexion while the sagittal function governs movements of adduction and abduction.

The utricular organs function synergetically, and consequently each displacement of the head in the sagittal plane causes an equal stimulation of both of these organs. This stimulation is at its maximum when the head is inclined forward to an angle of 30 degrees; inversely, there is no stimulation of these organs if the head is inclined backward to the same angle. Hence there is a position of maximum and also a position of minimum stimulation.

In the position of maximum stimulation the attitude is in flexion, and the tonus of the flexors is increased to the maximum. On the contrary, in the position of the minimum excitation there is an increase in the tonus of the extensors.

The following test is used practically. In the index finger test the finger has a tendency to pass below its object when the stimulation is at the maximum; there is an increase in the tonus of the flexors. This result may be modified in cases in which there is a disorder of the utricular function. If there is hyperexcitability the finger will always pass below the object even if the head is in the position of minimal stimulation. The tonus of the flexors remains predominant in relation to the tonus of the extensors.

In cases of hypo-excitability or paralysis of the utricular organs there is a predominance of the tonus of the extensors, and in the index finger test the finger will pass above the object.

The saccules are antagonistic organs; that is, when one is in a state of hyperexcitation the other is in a state of hypo-excitation. Consequently, in any given position of the head there is always a maximal excitation for one side and a minimal excitation for the other. When the head is inclined toward the left shoulder it is in a position of maximal excitation for the right saccule, and the inverse position corresponds to the maximum excitation of the left saccule.

Stimulation of the saccules produces movements of abduction while hypostimulation causes movements of adduction. For example, when the head is inclined toward the left shoulder there is a maximal stimulation of the right saccule, and movements of abduction are observed on the right side. If there is hyperexcitation on one side the movements of abduction predominate, even if the degree of stimulation is carried to the minimum on the same side. On the contrary, in cases of paralysis not only are the movements of abduction not observed, but the predominance of the adductors persists even in the position of maximum stimulation.

The foregoing tests are those recommended by Quix, but they have not yet undergone the test of time. Other tests have been advised, such as the investigation of the ocular manifestations during otolithic stimulation. The position of the ocular globes corresponding to a determined position of the head has been attributed to the otolithic function. Thus, when the head is inclined forward, the eyes undergo an opposite displacement, and the direction of the eyes with relation to the position of the head is an otolithic manifestation. A nystagmus and vertigo have also been described as being of otolithic origin. Inclination of the head in a certain direction under pathologic conditions causes vertigo and nystagmus either by irritation or by paralysis. The vertigo and nystagmus appear only a few seconds after the movement of the head, and they are reproduced each time that the same movement is repeated. They persist as long as the head remains in that particular position. This otolithic reflex can be differentiated from the nystagmus of the semicircular canals because the latter is immediate and transitory. Practically it is difficult to determine the part played by an otolithic disorder in the production of nystagmus, but a knowledge of this otolithic nystagmus shows the complexity of ocular motor disorders in vestibular disease.

LABYRINTHINE PHYSIOLOGY

Wittmaack,[19] who has contributed so extensively to the existing knowledge of the histology, physiology and pathology of the ear, gave a most interesting discussion as to the tonus of the sensory terminals of the inner ear. He stated that similar to the eye, the stimulation process in the auditory organ is decomposed in the inner ear into components, the pure physical factor of which gives rise to the physical conditions necessary for the occurrence of stimulation and the biologic process at the sensory terminals themselves through which the stimulation is conducted to the peripheral nerve apparatus.

On the basis of its anatomic structure as well as its morphologic character, the vestibular apparatus may be considered as a sensory organ, and may be designated as conferring a "sixth sense." The functional significance of this organ is just as important as that of any other sensory organ. This organ differs essentially from other sensory organs in only one point: Contrary to the behavior of other sensory organs, the stimulation process occurring in it does not come to the conscious mind. The sensory terminals of the vestibular apparatus receive their stimuli not through the influence of the surroundings, as other sensory organs do, but through the relation of the organism itself to the surroundings or to space. The vestibular apparatus is in

19. Wittmaack, K.: Arch. f. Ohren-, Nasen- u. Kehlkopfh. **126**:162, 1930.

man, mammals and birds "an inner organ." One becomes aware of the presence of such organs only when their function is disturbed as a result of some external or internal influences. This is especially true of the vestibular apparatus. The fact that a disturbance in its function is relatively rapidly compensated does not necessarily indicate that the vestibular organ is not absolutely essential to existence and also cannot be replaced; the same holds true for a number of other inner organs and for most of the other sensory organs in general. The very fact that the least disturbance is registered definitely in the conscious mind indicates the functional significance of this organ.

The fact that relatively slight disturbances in the function of this organ give rise to severe symptoms indicates that one has to deal here with an important functional as well as an extremely sensitive organ which reacts to the slightest stimulation. The various types of reaction known in reference to the vestibular apparatus show definitely that there occur within this organ, following the application of a single stimulus, numerous stimulation processes having an opposite direction. It is assumed, therefore, that the vestibular apparatus represents a sensory organ of considerable physiologic significance with a pronounced specific sensory sensitiveness, the function of which is to maintain, in association with other organs, the equilibrium of the body. If the function is normal, it is not registered by the conscious mind. Definite changes in the position of the body or definite movements serve as stimuli for the sensory terminals of the vestibular organs; as a result of the stimulation process in the individual sensory terminals there occur definite reflexes in definite muscle groups. The normal condition of the sensory terminals of the vestibular apparatus is not rest but a slight degree of irritation. For the production of a stimulus a very weak impulse is necessary. During physiologic conditions one is not aware of these processes of stimulation or of the reactions produced by them. The process becomes objectively recognizable only when it produces reflexly definite muscular reactions, one of which is expressed in the form of nystagmus and is used clinically as a means of testing the condition of the vestibular apparatus. Clinically, therefore, a nonphysiologic form of stimulus is used, viz., an excessive or paradoxical stimulation; in spite of this, the results obtained enable one to judge the functional condition of the vestibular apparatus.

Wittmaack discussed at great length the purely physical processes of stimulation as it occurs in the vestibular apparatus, and then described the biologic processes of stimulation as follows.

The question arises to what degree the individual elements of which the vestibular organ is composed participate in the process of stimulation or through what element the actual perception of the stimulus takes place. One is inclined to believe that the sensory cell of the

sensory organ is the primary perception point of the stimulus; the same holds true for the eye; it is less true for the pressure of palpatory sense. Whether the conduction of the sensory stimulus to the sensory nerve depends on the biologic function of a physical conduction apparatus and perceptive nerve fiber apparatus, which contains a peculiar sensory cell apparatus, is conditional on the quality of the stimulus that is to be perceived. In reference to the vestibular apparatus the following may be stated: Definite conclusions with reference to the functional significance of the sensory cells cannot be drawn; the author is inclined to believe that not the sensory cells but the peripheral nerve fibers represent the actual elements of perception of the stimulus. It has been shown experimentally that an injury to the sensory cells conditions only slight functional disturbances. Wittmaack is of the view that the neuro-epithelium of the vestibular apparatus represents a functional unit, but it functions mainly as a physical conducting apparatus without exercising a purely sensory biologic function. This conduction apparatus serves chiefly for the conduction of the stimulus to the peripheral nonmedullated nerve endings; only the latter form the elements of perception in the course of the process of stimulation; this explains why considerable degeneration of the sensory elements of the vestibular apparatus is followed by only a slight functional impairment. On the foregoing basis it is reasonable to assume that the neuro-epithelium of the vestibular apparatus does not represent a highly differentiated organ, and consequently its regenerative ability must be pronounced. Wittmaack is inclined to believe that the lack of considerable functional disturbances following an isolated destruction of the macula sacculi is due to the fact that here a destruction of the nonmedullated nerve terminals does not take place, and even if a slight involvement of the nerve terminals does not occur, the latter possess a considerable degree of regenerative ability. The experimental destruction of the vestibular organ or the destruction of the vestibular organ resulting from a diseased process is well compensated; this compensation is due, to a large extent, to the regeneration of the peripheral nerve fibers and to the adjustment of the former to the changed conditions of stimulation.

Adlersberg and Forschner [20] studied the effect of forced respiration (hyperventilation) in twenty-five cases. This investigation was to determine the influence of changes of the acid-base equilibrium on the excitability of the vestibular apparatus. In normal experimental subjects the excitability of the vestibular apparatus was first tested by means of the rotation test with erect head, or by means of the caloric minimal reaction according to Kobrak. The subjects were then

20. Adlersberg, D., and Forschner, L.: Klin. Wchnschr. **10**:828 (May 2) 1931.

instructed to hyperventilate strongly for from five to fifteen minutes, whereby the appearance of signs of tetany—Chvostek's sign and others—was looked for. Immediately after the termination of the hyperventilation the vestibular excitability was again tested, in the same manner as previously. A distinct increase of the excitability of the vestibular apparatus was found in nineteen of the twenty-five persons. This hyperexcitability expressed itself subjectively as well as objectively. Subjectively a much stronger feeling of dizziness could be elicited than during the first test; several cases showed nausea; some patients vomited. Objectively, an increase of the degree could be observed in several subjects, and in all there was a protraction of the duration of the nystagmus, occasionally to double the time previously noted. In cases in which the caloric test was made, the latent period was shortened, and the duration of the nystagmus was protracted. In some cases the period of latency was the same and only the duration of the nystagmus was longer.

The authors stated that the neurotic labyrinth vertigo observed by Alexander and Braun following deep breathing in examinations of the lung is attributable, in part at least, to the changes described.

When the increase of the vestibular excitability that occurs following hyperventilation develops on the basis of a displacement of the blood reaction to the alkaline side, it is to be expected that after other measures having the same effect the same results will be obtained. Ten experiments were made on normal subjects in whom the vestibular excitability was determined by means of the rotation test before the administration of from 20 to 45 Gm. of sodium bicarbonate by mouth and from one to one and a half hours after its administration. In regard to the subjective condition of the experimental subjects no positive change was demonstrable. In eight cases, however, an objective increase of the vestibular excitability was unequivocal. The increase of the excitability was quantitatively lower after the administration of sodium bicarbonate than after hyperventilation.

It is therefore apparent that the hyperventilation and the administration of sodium bicarbonate influenced the excitalility of the vestibular apparatus in the same sense, even if there were quantitative differences. It was left undecided whether these quantitative differences were due to the different intensity of the effect or perhaps to the different nature of the selected measures. The stronger effect of the hyperventilation, at least with the technic selected by the authors, was also expressed by the fact that the effect of sodium bicarbonate can be further increased by subsequent hyperventilation. This further increase, however, soon subsides after the cessation of the hyperventilation, while the increase caused by the effect of the sodium bicarbonate persists for a long time (about one and a half hours).

Experiments with a view to influencing the excitability of the vestibular apparatus by acidotic measures in an opposite sense have so far led to negative results in normal experimental subjects. The authors stated that they will publish further experiments, possible explanations and practical conclusions in a more detailed article.

DeKleyn [21] and Schenk described the reflex arc for vestibular nystagmus in man. It has been shown experimentally in animals that vestibular nystagmus with a slow and quick component can be excited: (1) after removal of the cerebellum; (2) after removal of the cerebrum; (3) after division of both trigeminal nerves and of the motor nerves to all the ocular muscles, with the exception of that to one external rectus; (4) after removal of the nuclei of the third and fourth cranial nerves, and (5) after transverse section of the medulla at a level just below the lower limit of the eighth nucleus.

Recently de Kleyn and Schenk had the opportunity of testing the ocular reflexes in an anencephalic infant that lived for one week. A vestibular nystagmus with a slow and quick component was elicited on both sides.

Post mortem it was found that (1) the cerebrum was absent, (2) the cerebellum was absent, (3) in each eye there was only one muscle and the nerve supplying it, the external rectus, (4) the only oculomotor nerve nuclei were those of the sixth nerves and (5) the sensory epithelium of the labyrinth and the vestibular nerve and its nuclei were present on both sides.

This confirms the findings in animals, and proves that the reflex arc for vestibular nystagmus in man, as in other animals, consists of the peripheral labyrinth, vestibular nerve, vestibular nucleus, abducens nucleus, abducens nerve and external rectus muscle.

SEMICIRCULAR CANAL

This clinical demonstration by Cleminson [22] seems to corroborate the experimental work of Tait and McNally who previously worked on decerebrate frogs and recorded definite responses of the limbs in those with intact labyrinths which prevented them from being displaced when set on a tilt table. In those animals in which either the anterior or the posterior vertical canals were destroyed there was a definite lack of response in either the fore or the hind leg. If both were destroyed, both limb responses were absent. In a later paper, Tait and McNally showed that the reflex between the vertical canals and the limb is not confined to the extension of one limb only but involves a simultaneous

21. deKleyn, A., and Schenk, V.: Acta oto-laryng. **15**:439, 1931; abstr., J. Laryng. & Otol. **46**:508, 1931.

22. Cleminson, F. J.: Acta otol.-laryng. **15**:393, 1931.

flexion of the others; thus if the right arm is extended under the influence of the right anterior canal the left arm and legs are flexed at the same time, and in this way the protective character of the reaction against falling is reenforced and the position of the head is maintained.

Cleminson's case was in a young woman who following parotitis had no response in the left labyrinth. The right ear was normal. The author tested the patient in an improvised manner as he did not have a tilt table, and he found that the limb responses on the left side (the affected labyrinth) were absent. He stated that three months later the experiment was repeated on a tilt table and the reactions on the two sides of the body were identical, that is, normal; yet hearing and caloric tests showed that there had been no reaction of the left labyrinth. In some way compensation had been established as far as limb reactions were concerned. He ventured to say that possibly the joint and muscle sensations aided by cutaneous sensations or perhaps by extension of the functions of the right labyrinth caused the compensation.

VESTIBULAR PHYSIOLOGY: PASTPOINTING

Bárány,[23] who is constantly devising methods of improving the registration of the pastpointing error, considered this his latest improvement.

In testing the pastpointing error, the experimental subject touches first the zero point of a line drawn perpendicularly to the longitudinal lines of a paper. He is next directed to raise the arm at an angle of about 70 degrees and then lower it; these up and down movements must last from about two to two and a half seconds. The point at which the paper is touched again is marked 1. Next the patient is instructed directly after touching the paper, to lift his arm straight at from about 5 to 10 cm. above the point that was touched and to hold it still in this position. The experimenter observes in what direction the arm is lifted and whether it is held still in this position or whether it deviates to one or the other side.

The experiments with pastpointing are usually arranged in such a manner that the zero point is touched by the anteriorly extended arm; if the zero point is touched by the abducted or adducted arm, this must be indicated by a corresponding sign on the paper. In this manner the various deviations are directly plotted in the form of a curve. Care must be taken to prevent the patient's knowing the mistake that he has made. A number of experiments carried out in the manner given have shown that this method permits the detection of even the slightest reaction and also permits a differentiation from

23. Bárány, R.: Arch. f. Ohren-, Nasen- u. Kehlkopfh. **126**:65, 1930.

spontaneous pastpointing. The direct registration of the results is of considerable advantage; the results obtained can hardly be misinterpreted. In a number of experiments carried out on patients suffering from multiple sclerosis in whom no neurologic symptoms were present, other than a rotatory nystagmus and some dizziness, the curves obtained were characteristic. This modification of the pastpointing test was found to be very useful.

VASOMOTOR APPARATUS

Marinesco and his co-workers [24] described the vestibulovegetative reflex in man. It has been known for some time that stimulation of the vestibular apparatus is followed by certain manifestations of a vegetative order, such as nausea, vomiting and pallor, in addition to nystagmus and tonic phenomena. Spiegel and Demetriades have made a careful study of the physiologic mechanism of the vegetative phenomena in animals. Marinesco has investigated the relations that exist between the vestibular apparatus and the vegetative system in man under normal and under pathologic conditions. In this preliminary note only the results obtained in normal man with regard to the clinical and experimental vestibular reactions will be considered. Irrigation of one ear with cold water (26 C.) produced the following vegetative reactions in normal man: 1. The pulse diminished about 8 or 10 pulsations at the beginning of the irrigation at the time when the nystagmus appeared; it returned slowly to the original level and became slightly accelerated when the irrigation ceased. 2. The blood pressure varied slightly, but in certain patients a decrease of 10 mm. was noticed, and this was maintained for a considerable time even after cessation of the irrigation. 3. The oscillometric index increased in certain cases, and this was clearly shown in curves made with a registering apparatus. 4. Microscopic examination of the capillaries under the nail showed that there was a manifest constriction when the nystagmus appeared; this constriction was observed in the afferent branch and was prolonged in the form of a peristaltic wave to the loop and even to the efferent branch; this peristaltic movement was repeated several times, and then the vessel commenced to dilate, and circulation became more active. 5. The plethysmogram of the arm showed a vasoconstriction, which reached its maximum at the time when the nystagmus appeared; it was followed by a progressive dilatation which persisted for some time after cessation of the test; this vasodilatation was more marked when the subjective symptoms, such as nausea and vertigo, were more pronounced. 6. The respirations became more ample and sometimes diminished in frequency.

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24. Marinesco, Draganesco, Kreindler and Bruch: Compt. rend. Soc. de biol. **106**:103 (Jan. 23) 1931.

These results should not be considered as an average in normal man because there were individual variations which were probably related to the general vegetative reaction of the individual. The production of vegetative phenomena after stimulation of the labyrinth can be explained by the anatomic connections present in the bulb between the vestibular centers and the adjacent vegetative formations. These phenomena should be considered as true reflexes, and can be termed vestibulovegetative reflexes. In order to obtain a better understanding of the physiologic mechanism, Marinesco and his co-workers are carrying out these tests in different pathologic conditions of the cerebellovestibular apparatus, which must be considered as the afferent route of the reflex, and also of the vagosympathetic apparatus, which constitutes the efferent route.

Muck [25] found that in normal persons nystagmus could be produced if the head is kept for five minutes in an extreme lateral position. He thought that this was due to a tension of one of the vertebral arteries and that this mechanical irritation of the periarterial plexus of the sympathetic nerve caused disturbance of the tonus of the innervation of the origin of the basilar and of the posterior cerebellar arteries. In other words, he regarded this phenomenon as a retrolabyrinthine angioneurotic nystagmus. The author's experiments showed that in many normal persons a nystagmus may be obtained by mechanical, thermic and electrical stimulation, distant from the labyrinth; this nystagmus also appears five minutes after the irritation. The sympathetic plexus of an artery of the anterior extremity was subjected to the aforementioned stimuli. The author thought that if his hypothesis of the origin of the nystagmus caused by turning of the head to the side was correct, the mechanical irritation of the sympathetic plexus of the arteries of the anterior extremity must also cause nystagmus.

Bilancioni [26] studied the influence of vascularization on the labyrinth reflex. It is known that the labyrinth, which is especially sensitive to vasomotor reactions, is irrigated by only one artery, the external auditory artery. He considered that the rich blood supply of the internal ear was important and offered the principal point for the study of the vestibular reflex. He related and pointed out the clinical relationship between vascular disease of the inner ear, either cochlear or semicircular canal manifestations (deafness, dizziness, tinnitus, etc.). He described the pathologic reports of Politzer who showed arteriosclerosis in a 70 year old man. Alexander showed a similar process affecting the basilar and the external auditory artery. The author also reported four cases of arteriosclerosis observed by Bruhl. Bilancioni

25. Muck, O.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **28**:22 (Dec.) 1930.

26. Bilancioni, G.: Valsalva **7**:87 (Feb.) 1931.

commented on the work of Lannois and Gaillard who resected the cervical sympathetic nerve and obtained a marked modification of nystagmus. Similarly, a number of authors were quoted to prove that the vascularization of the carotid and cervical sympathetic nerve on the vestibular labyrinth is definitely evident. With this information to assist him, Bilancioni conducted a series of experiments on rabbits.

He reduced the lumen of the vertebral artery in certain animals without occluding the vessel all at once. By this he proposed to study the degree of irrigation of the labyrinth. He found, however, that for practical purposes experiments of this sort are difficult because it is hard to control the pressure of the small syringe to the necessary extent. If the compression is not sufficiently strong the vessel will remain almost normal, and if the douche is entirely too strong the lumen will be obliterated. The author therefore used complete ligation. After he had noted the poor results of simple ligation of the primary carotid artery he ligated the vertebral artery, also in view of the fact that this artery is in intimate relation with the internal auditory artery. The animals were also given a hot water and a cold water bag on both sides of the auricular region in order to stimulate contrary reactions in the labyrinth.

The experiments showed that simple ligation of the carotid artery, irrespective of whether the ligation was separate or combined with that of the vertebral artery, did not produce such evident and constant modifications as could be used in proof of a slight diminution of excitability of the labyrinth on the side on which the operation was performed. The modification differed frequently, and in some cases it was slight. The application of warm or cold objects did not cause any marked modifications, and the sudden change from one to the other also failed to cause any particular modification. This showed that another factor was responsible for the modifications, and for that reason the author undertook a series of experiments on the irrigation of the temporal artery and internal ear, the results of which will be reported in another article.

Bilancioni also made a study of the alterations of the labyrinth in animals. The first experiments were reported in 1928. Subsequently he conducted several experiments. In the meantime a report by Beltran appeared which confirmed the author's experiments in this connection.

Bilancioni termed the absence of modifications of nystagmus constant absence. He showed that it was difficult to modify the circulation of the labyrinth by compression or ligation from a distance. He will continue his experiments and report in another article his findings on the resection of part of the vertebral artery and on the resection of the vertebral nerves.

Abstracts from Current Literature

Ear

ROENTGENOLOGIC STUDY OF MASTOID IN INFANTS. CHARLES L. MARTIN, Am. J. Roentgenol. **22**:431 (Nov.) 1929.

A review of the literature reveals some diversity of opinion as to the time of pneumatization of the mastoid in infancy. After 6 months of age a cavity having the shape of the mastoid can be demonstrated below the tegmen tympani and behind the external auditory meatus in good roentgenograms. The cavity varies markedly in size and may measure as much as ¾ inch (1.9 cm.) in diameter and show definite cell structure at 9 months. Diploetic mastoids are probably such from the start, whereas cellular mastoids begin as large single cavities which slowly increase in size and usually begin to show cellular structure at from 9 to 16 months. The presence of pathologic conditions of the mastoid can usually be detected in good roentgenograms after the age of 6 months, though double infection often makes interpretation difficult. A bibliography is appended.

STULIK, Chicago [AM. J. DIS. CHILD.].

A NEW AND EFFECTIVE NON-SURGICAL METHOD FOR THE TREATMENT OF CHRONIC SUPPURATION OF THE MIDDLE EAR. CHARLES HYMES, Minnesota Med. **14**:1054 (Dec.) 1931.

The author recommends insufflation into the middle ear, by means of low pressure, of a mixture of potassium iodide crystals, 1 part, and powdered boric acid, 3 parts. The treatment is continued from two to three times weekly, seldom longer than three weeks. Marked success is claimed even when a chronic discharge persists after a radical mastoid operation. Hymes reports in some detail a series of twenty cases.

HUENEKENS, Minneapolis [AM. J. DIS. CHILD.].

BLUE SCLEROTICS AND ASSOCIATED DEFECTS: STUDY OF FOUR FAMILIES WITH NOTES ON THEIR MINERAL METABOLISM. G. H. STEVENSON and D. P. CUTHBERTSON, Lancet **2**:782 (Oct. 10) 1931.

Stevenson and Cuthbertson give pedigree tables of four families one or more of whose members have suffered from one or more of the associated defects of bone fragility, blue sclerotics, otosclerosis and liability to dislocations and sprains. Metabolic studies revealed definitely diminished retentions of calcium, phosphorus and magnesium in two children affected with associated defects of bone fragility, blue sclerotics and hypotonicity of ligaments. There did not appear to be any marked deviation of these minerals from the normal excretory paths in these children and in two adults studied. The concentration of calcium and phosphorus in the blood was normal. Viosterol and cod liver oil did not appear to have any specific effect on these abnormalities.

[J. A. M.A.]

MASTOIDITIS AND THROMBOPHLEBITIS OF THE LATERAL SINUS. C. M. CRISCUOBO, Rev. de especialid. **6**:839 (Sept.) 1931.

The condition occurred in an 8 year old child following otitis media. An operation was performed; postoperative washings with surgical solution of chlorinated soda were carried out, and polyvalent vaccine was given. The child recovered.

SANFORD, Chicago [AM. J. DIS. CHILD.].

AN ASCARIS IN THE MASTOID PROCESS. K. B. STEINMAN, Rev. med. de Chile **59**:167 (Feb.) 1931.

In an 8 year old girl an ascaris was removed from the right mastoid process during an operation for acute mastoiditis which followed an attack of scarlet fever. The symptoms appeared three days before the operation. The parasite was alive when found and was properly identified at the zoological laboratory. The three possible modes of entrance are: (1) the external acoustic meatus, (2) the blood stream (hematogenous) in a microscopic stage and (3) the eustachian tube (this seems to be the most probable one).

SCHLUTZ, Chicago [AM. J. DIS. CHILD.].

THE RETICULUM OF THE CILIATED CELLS OF THE LABYRINTH OF THE MOUSE, AND ITS INDEPENDENCE FROM THE NERVE ENDINGS OF THE EIGHTH PAIR. J. F. TELLO, Trav. du lab. d. recherches biol., de l'Univ. de Madrid **27**:151, 1931.

The material used consisted of mouse embryos at diverse stages of development and young mice. In addition, embryos of other mammals and of birds were examined. The ciliated cells of the cristae, maculae and cochlea contain in their cytoplasm a reticulum, which in all probability is some sort of supporting framework for the cilia. There is no continuity between the intracellular reticulum just mentioned and the nerve endings, as has been indicated by Kolmer and by London and Pesker. The nerve fibers end on the ciliated cells by means of calyces, bands or fibers enveloping the cell bodies.

The nerve fibers enter the epithelium long before the formation of the intracellular networks of the ciliated cells, but the nerve endings proper do not appear until long after the reticulum of each ciliated cell is completely developed.

As in the case of the formation of other nerve endings studied by the author, the phase of specific sensibility must be preceded by other stages of diffuse sensation, which might be compared with Head's protopathic sensibility. This sensation is probably received by the plexuses and bundles of fibers entering the epithelium before the definitive nerve endings are formed.

The cytoplasm of the ciliated cells may contain rings, first noticed by Kolmer, and seen later by Bielschowsky and Brühl. Tello regards these rings as fragments of reticulum deeply stained in partial impregnations or in altered cells. From his observations the author concludes that the ciliated cells are epithelial elements and not neurons as has been suggested by some authors.

NONIDEZ, New York [ARCH. NEUROL. & PSYCHIAT.].

THROMBOSIS OF THE CAVERNOUS SINUS FOLLOWED BY RECOVERY. C. E. BENJAMINS, Monatschr. f. Ohrenh. **65**:1489 (Dec.) 1931.

Benjamins reports a case of otogenous thrombosis of the cavernous sinus which was followed by recovery. After discussing the sources, symptoms and therapy of thrombosis of the cavernous sinus, the author describes a case from his own practice which he thinks interesting because it clearly shows the course of this disease. A boy, aged 15, came to the hospital because of an acute inflammation of the ear. Operation on the ear revealed a cholesteatoma of the middle ear and thrombosis of the transverse sinus, which was spreading into the emissary vein of the mastoid and the cervical muscle. Twelve days after the operation, while the infectious foci opened during operation were still draining and the newly developing abscesses of the neck were being treated, the first symptoms of cavernous thrombosis, paralysis of the eye muscles, appeared. Paralysis of the pupils appeared first and was followed by paralysis of the exterior muscles of the eye and protrusion of the eyeball. There was no stasis in the fundus occuli, but later there appeared cyanosis of the eyelids, thickened veins and other symp-

toms of congestion. The ocular symptoms were followed by a number of abscesses, indicating a spread of the thrombosis in all directions from a central focus, in this case the two cavernous sinuses. The symptoms of the spreading thrombosis included orbital abscesses of both eyes, detachment of the left retina, a parotid abscess on the same side and a parapharyngeal abscess. Incision, withdrawal of pus, daily cleansing of the abscesses with hydrogen dioxide and the introduction of cigaret drains resulted in a gradual healing of all abscesses and recovery of the patient. The author points out that, while the patient had the usual septic symptoms, cerebral symptoms were lacking.

EDITOR'S ABSTRACT.

THEORY OF LABYRINTH FISTULA SYMPTOM. R. LUND, Monatschr. f. Ohrenh. **65**:1511 (Dec.) 1931.

Lund discusses the theories that have been advanced by other writers in explanation of the labyrinth fistula symptom and then presents his own theory which is a development of Mygind's conception of the fistula symptom as an otolith reaction to an adequate irritation. The author thinks that pressure nystagmus may be ascribed in part to displacement of the crista ampullaris, as pressure causes an endolymph movement which displaces the crista, but the reaction is also due to the general pressure effect on the static sensory epithelium of the labyrinth. In cases of fistula of the semicircular canal the reversed fistula symptom produced by direct, or indirect, pressure on the fistula may be ascribed to the effect of pressure on the sensory epithelium of the vestibule and the semicircular canal, whereas the reversed fistula symptom when produced by direct pressure in the region of the fenestra may be ascribed to endolymph displacement in the semicircular canal. The regular fistula symptom, whether produced directly or indirectly, may be ascribed to the effect produced on the crista ampullaris by an endolymph movement toward the ampulla. The effect on the crista supersedes the general pressure effect on the sensory epithelium and therefore determines the direction of the nystagmus. In cases of fistula of the fenestra region, the reversed fistula symptom is always purely a pressure symptom, while the direction of the regular fistula symptom may be determined by an endolymph movement toward the ampulla over the crista ampullaris. No matter where the fistula is located, the general pressure effect will help to determine the nystagmus, which may therefore be considered as consisting of all three components, the horizontal, rotatory and vertical. When pressure effect supersedes endolymph movement effects, the nystagmus is determined by the functioning capacity of the sensory epithelium. The statement of the theory is followed by a long discussion in which the author shows how the clinical and experimental observations recorded in the literature, as well as his own clinical observations, are explained by his theory.

EDITOR'S ABSTRACT.

BILATERAL TOTAL DEAFNESS. O. VOSS, Monatschr. f. Ohrenh. **65**:1537 (Dec.) 1931.

Voss reports two cases of bilateral total deafness, one of which originated from an osteomyelitis, the other from parotitis. The author discusses the two cases as to the pathologico-anatomic basis of the disease and therapy and gives a detailed review of the literature on the subject.

EDITOR'S ABSTRACT.

CICATRICIAL OCCLUSION OF THE EUSTACHIAN TUBE. A. VON GYERGYAY, Ztschr. f. Hals-, Nasen- u. Ohrenh. **30**:240 (Dec. 18) 1931.

Von Gyergyay thinks that the understanding and application of the technic of examination of the eustachian tube and approach to its pharyngeal opening can be of great clinical value. The technic has been so perfected recently that the finest operation can be executed with precision under visual control. To demonstrate the value of this method he describes a case of deafness due to

cicatricial occlusion of the pharyngeal opening of the eustachian tube following an operation on the lower turbinate bone. The methods of examination, the instruments used, the steps leading to operation, the operation and postoperative therapy, which resulted in a restoration of hearing, are described in detail.

EDITOR'S ABSTRACT.

Pharynx

LUNG ABSCESS FOLLOWING TONSILLECTOMY. JOSEPH S. WALL, Arch. Pediat. **48**:687 (Nov.) 1931.

The author speculates concerning the "remarkable circumstance that lung abscesses following tonsillectomy have been recognized only during less than a score of years." The incidence of pulmonary abscess from this cause is discussed, and the various theories concerning the etiology of such abscesses are presented. The symptomatology, diagnosis, prognosis and treatment are discussed.

WADDELL, University, Va. [AM. J. DIS. CHILD.]

TONSILS AND ADENOIDS IN RELATION TO TUBERCULOUS INFECTION. MICHAEL ALASTO, Brit. J. Tuberc. **25**:129 (July) 1931.

Secondary infection of the tonsils in adults suffering from advanced pulmonary tuberculosis is relatively common, probably owing to contact with bacillus-laden sputum. In children the sputum is usually swallowed, and involvement of the tonsils rarely occurs. Primary tuberculosis of the tonsils is, in most cases, due to infection with the bovine bacillus, which enters the system by way of the alimentary tract. Except in rare instances, the clinical diagnosis of tuberculosis of the tonsil is impossible. The appearance of the organ is no guide whatsoever in the recognition of the condition. The presence of an enlarged gland in the area between the upper part of the sternocleido mastoid muscle and the lower jaw immediately over the posterior belly of the digastric muscle, while indistinguishable from infection by the usual pyogenic organisms, is perhaps the most suggestive sign of tuberculous infection involving the tonsil.

SMITH, Ogden, Utah [AM. J. DIS. CHILD.].

NON-DIPHTHERITIC SORE THROATS. R. SCOTT STEVENSON, Practitioner **128**:57 (Jan.) 1932.

The author lays stress on the point that one must make quite certain that throat conditions in this group are indeed nondiphtheritic. As he states, the so-called typical foul odor of a diphtheritic throat is very like the so-called typical fetor of Vincent's angina. Stevenson notes that usually the diphtheroid inflammation of the throat is due to the streptococcus, but that it may be accompanied by the staphylococcus, pneumococcus or Hoffmann's bacillus. The precise relationship between acute streptococcal tonsillitis on the one hand and scarlet fever, acute otitis media, acute rheumatism or acute appendicitis on the other is still a matter for discussion, but many believe that there is a close association. The treatment that the author uses for acute streptococcal tonsillitis is to swab both tonsils carefully with tincture of iodine. He states that two or three applications may be required. Other conditions of the throat discussed include peritonsillar abscess, Vincent's angina and Ludwig's angina.

SAPPINGTON, San Francisco. [AM. J. DIS. CHILD.]

PERITONSILLAR ABSCESS AND MYDRIASIS. T. and S. HORNING-WENGER, Rev. d'oto-neuro-opht. **9**:580 (Oct.) 1931.

In patients of all ages with unilateral quinsy, the homolateral pupil was found to be dilated. The sign is clearer when the distention from the abscess is greater.

The authors have had the experience of draining the abscess and seeing the mydriasis disappear; when iodized poppy-seed oil 40 per cent was injected into the abscess cavity, the sign reappeared. A roentgenogram showed the cavity to be water tight, with complete closure toward the tissues of the neck. The mydriasis again disappeared when the cavity was emptied anew; the mechanism of its production is either by direct irritation of the sympathetic system or by a "repercussivity" of bulbar origin.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL. & PSYCHIAT.].

EPIDEMIC SEPTIC PHARYNGITIS WITH SEVERE ENTERITIS. B. EXNER and H. KOTRNETZ, Jahrb. f. Kinderh. **132**:169 (July) 1931.

An epidemic of forty cases of pharyngitis with acute enteritis and pneumonia due to the hemolytic streptococcus is described. Favorable results are ascribed to polyvalent autogenous vaccines and antistreptococcus serum.

CLAUSEN, Rochester, N. Y. [AM. J. DIS. CHILD.].

CYSTS OF THE NASOPHARYNGEAL CAVITY. G. FINDER, Monatschr. f. Ohrenh. **65**:1430 (Nov.) 1931.

Finder states that in the discussions on nasopharyngeal cysts, their origin has always been of great interest. He became interested in this problem after observing two cases, of which he gives the clinical histories. He is convinced that on the basis of their structure and contents a differentiation of nasopharyngeal cysts into those of the bursa pharyngea and those of the nasopharyngeal tonsil is not possible. The large cysts that usually fill the nasopharynx almost completely probably originate in the bursa pharyngea. The usually extremely small cysts that occur in a normal sized or in a hyperplastic pharyngeal tonsil, generally remain without clinical symptoms, and during the microscopic examination they can usually be identified as cysts of the pharyngeal tonsil. However, if the cysts are larger and a connection with the pharyngeal tonsil is not detectable, or the pharyngeal tonsil is no longer present, the question of the origin of the cyst will often remain unanswered. In such cases the diagnosis of nasopharyngeal cyst has to suffice.

EDITOR'S ABSTRACT.

PATHOLOGICO-ANATOMIC FACTORS IN DEVELOPMENT OF TRAUMATIC TONSILLITIS. R. WALPAPFEL, Ztschr. f. Hals-, Nasen- u. Ohrenh. **30**:245 (Dec. 18) 1931.

Waldapfel reports his study of the pathologico-anatomic changes following nasal operations that prepare the way for the development of tonsillitis. Nasal tamponade and galvanocautery are the two operations most frequently followed by tonsillitis. The author first studied the changes that generally occur following these operations, and then studied the changes following these operations in cases later complicated by tonsillitis. Bacteriologic investigation revealed that the bacterial flora, which is slight in the normal nose, is greatly increased by all types of tamponade. However, hemolytic streptococci in pure culture were obtained from the nose following tamponade or galvanocautery only in those patients in whom traumatic tonsillitis later developed. The pathologico-anatomic changes observed following tight tamponade with white gauze were partial destruction of the superficial epithelium down to the basal membrane, hyperemia and leukocytic infiltration of the adenoids and the upper glandular layer. Iodoform gauze produced similar changes, but these were sometimes more extensive, consisting in small circumscribed areas of necrosis. In the cases in which tonsillitis developed, the mucous membrane following tamponade was characterized by widespread destruction and necrosis extending into the erectile tissue layer and opening of the glandular and vascular lumina, which were frequently thrombosed. In this pathologically changed tissue, hemolytic streptococci were found in almost pure

culture. Similar changes were observed following galvanocautery in a case in which traumatic tonsillitis developed. In the light of these observations, the tonsillar changes following nasal tamponade are noteworthy. Following nasal tamponade gram-positive streptococci were found in large numbers within the follicles of tonsils that were clinically not diseased. The author thinks that this invasion of the parenchyma by gram-positive streptococci, which has never been observed in a clinically healthy tonsil, but is known to be extensive in lacunar tonsillitis, might be looked on as the last link in a chain leading from endonasal operation to the pathologic tonsillar changes occurring in tonsillitis. He thinks that the observations made on clinically healthy looking tonsils indicate that there is a close connection between the nose and the tonsils, experimental investigations being to the contrary.

EDITOR'S ABSTRACT.

Larynx

DIAPHONOSCOPY OF LARYNX IN EXPERIMENTAL PHONETICS. G. PANCONCELLI-CALZIA, Monatschr. f. Ohrenh. **65**:1307 (Nov.) 1931.

After giving a survey over the development of diaphonoscopy, Panconcelli-Calzia shows the advantages of this mode of examination of the larynx over laryngoscopy and endoscopy, particularly for phonetic studies. He points out that Czermak, in 1858, was the first to employ laryngeal diaphonoscopy, and then mentions several others who employed this method for phonetic investigations. But although the literature on this subject is comparatively large, the number of investigators who have employed diaphonoscopy for phonetic studies is small. The author assumes technical difficulties as the cause of this, and then describes a device that eliminates these difficulties. He further cites that diaphonoscopy often has been found to give more accurate results than roentgenoscopy, and that it has the advantage of being more economical and more rapid. It is also superior to episcopic laryngoscopy.

EDITOR'S ABSTRACT.

SIMULTANEOUS OCCURRENCE OF LARYNGEAL TUBERCULOSIS AND LARYNGEAL SYPHILIS. A. THOST, Monatschr. f. Ohrenh. **65**:1340 (Nov.) 1931.

Thost asserts that tuberculosis often takes root in syphilitic lesions of the larynx. He does not mean a primary tuberculosis of the larynx, but thinks that the organism, which has been weakened by syphilis and by antisyphilitic cures, develops tuberculosis, or an old tuberculous focus becomes active and then tuberculous infiltrates develop on the impaired sites of the larynx. It happens probably just as frequently that tuberculous patients contract syphilis. But syphilis that exists during active tuberculosis is often overlooked. For this reason the author describes a method of examination, which, if not in all cases, yet in some, helps to verify the diagnosis of syphilis, namely, the roentgen picture of the larynx of the living patient. He asserts that the arrangement of the calcium particles in the laryngeal cartilages is characteristic for the two diseases. In tuberculosis the calcium disintegrates, and the roentgen picture is blurred and shows indistinct outlines, whereas in syphilis osteophytes frequently develop on the cartilages and bones of the larynx, and as a result the roentgen picture is distinct and shows small, sharp, jagged, often star-formed and sometimes chainlike calcium particles. Following the clinical histories of eight patients, the author gives a review of the literature, and then relates that he subjected all the patients with pulmonary and laryngeal diseases in the state hospitals in Hamburg to roentgenoscopy. On the basis of these studies, he concludes that about 10 per cent of the tuberculous patients of a large city are syphilitic. In discussing the treatment, the author states that in the struggle of the two diseases tuberculosis as the stronger gains the ascendency. He therefore thinks that as soon as this is the case the treatment should be antituberculous rather than antisyphilitic, for in patients with active tuberculosis, syphilis is not progressive.

EDITOR'S ABSTRACT.

ROENTGEN THERAPY IN TUBERCULOSIS OF LARYNX. Z. SPECTOROWA, J. SOBIN and L. MELNIKOWA, Ztschr. f. Hals-, Nasen- u. Ohrenh. **30**:289 (Dec. 18) 1931.

Spectorowa and her co-workers discuss the use of roentgen therapy for tuberculosis of the larynx from the standpoint of prognosis and technic and present a report of eighteen cases in which this therapy was used by them. Favorable results from roentgen treatment may be expected when the tuberculosis is of the fibrous type, but in the exudative type the tuberculous process usually becomes more acute after roentgenization. Roentgen treatment is indicated in all cases in which the tuberculous process is in an initial, latent or slowly progressive stage. It may also be used to advantage when surgical removal of the pathologic tissue is impossible. The authors advise determining the sensitivity of the larynx to ultraviolet rays by percutaneous quartz irradiation. In the absence of any severe local reaction, such as hyperemia or swelling of the infiltrations, and any general reaction, such as headache or a rise in temperature, roentgen treatment may be instituted. In the event of a later appearance of one of the reactions listed, the course of treatment is to be interrupted for a period depending in length on the severity of the reaction. In the eighteen cases reported, which consisted in part of severe conditions, roentgen therapy resulted in two cures; ten cases showed marked subjective and objective improvement in the tuberculous process of the larynx, and in six this process became more acute. The advantage of being able to carry out this therapy on ambulatory patients is mentioned.

EDITOR'S ABSTRACT.

Nose

INFECTION OF THE ACCESSORY SINUSES AND UPPER RESPIRATORY TRACT IN AVITAMINOSIS OF RATS. R. G. TURNER and E. R. LOEW, J. Infect. Dis. **49**:244, 1931.

The bacterial flora of the nasal cavities and middle ears of ninety-two albino rats is reported. A comparison is made of the bacteria encountered in these localities when they present suppurative lesions with the flora when suppuration is absent. Staphylococcus aureus, chromogen 6 and the colon bacillus were the outstanding pyogenic organisms encountered in the suppurative lesions. The incidence of chromogen 6 was greater in the suppurative than in the nonsuppurative loci in the xerophthalmic animals. The variations in the percentage of the staphylococci were relatively slight, while colon bacilli were encountered most abundantly. Environmental conditions apparently played a part in the incidence of colon bacilli and of staphylococci. The age of the animal, the previous storage of vitamin and the season had no marked effect on the bacterial flora. Environmental conditions were not responsible for the increased incidence of chromogen 6. Comparison of the three series investigated showed that this organism gained in percentage incidence with increased severity of the disease produced by the withdrawal of vitamin A. Experimental evidence is given to substantiate the alterability of this organism toward the Gram stain. Provisionally it remains to be classified as a chromogenic, gram-negative cocus falling in group 6 of Gordon's classification. Chromogen 6 apparently has an elective affinity for the mucous membrane of the upper respiratory tract and nasal cavities. It fails to thrive when injected intraperitoneally or intramuscularly into common laboratory animals. The pathogenicity of chromogen 6 is attributed largely to the lowered resistance of the mucous lining of the nasal cavities, brought about primarily through withdrawal of vitamin A from the diet.

AUTHORS' SUMMARY. [ARCH. PATH.]

PURPURA AS COMPLICATION OF SUPPURATION OF MAXILLARY SINUS. G. V. T. BORRIES, Monatschr. f. Ohrenh. **65**:1476 (Dec.) 1931.

Borries describes an unusual case of purpura following suppuration of the maxillary sinuses. The author himself was the patient. The onset of the empyema

of the maxillary sinuses was followed on the fifth day by stiffness and swelling of the joints with slight pain and the appearance of purple patches on the lower extremities. After eight days of treatment with salicylates the symptoms disappeared, but a relapse followed soon afterward and thereafter relapses occurred at frequent intervals for five or six years, after which time they decreased in frequency. The extraordinary thing about these relapses was that they depended on climatic conditions, occurring only when atmospheric pressure was high, so that the patient, previously not sensitive to the weather, became a veritable barometer. The relapses were frequently accompanied by an eruption of erythema multiforme on the lower arms. The erythema usually followed mechanical irritation such as scrubbing, and the author notes that this factor has sometimes been observed in the development of purpura. The author classifies his case as one of purpura rheumatica and from an etiologic standpoint, further designates it as an infectious purpura, and submits it as the only case in his knowledge in which an infectious purpura followed empyema of the maxillary sinus.

EDITOR'S ABSTRACT.

INJURIES TO TEETH FOLLOWING RADICAL OPERATION ON THE MAXILLARY SINUS AND A SUGGESTION FOR THEIR PREVENTION. K. E. NAGEL, Ztschr. f. Hals-, Nasen- u. Ohrenh. **30**:265 (Dec. 18) 1931.

Nagel reviews the literature concerning injuries to the teeth following radical surgical procedure on the maxillary sinus and then reports his own observations on thirty-one patients who had undergone Denker's radical operation of the maxillary sinus. Contrary to Amersbach, he found few cases of anesthesia or hypesthesia of the teeth following this operation. Anesthesia was almost always limited to the canine teeth. Clinical examination for pulp necrosis in the anesthetic teeth always gave negative results. In no case was the patient aware of the anesthesia of the pulp nerves. Decreased sensibility of the gums frequently followed operation, but was usually of short duration and not disturbing to the patient while it lasted. The author attributes the small number of anesthetic teeth to the method in which Denker's operation is carried out in the Heidelberg clinic, where his investigations were made. This method, which is described in detail, consists in placing the incision very high so that the alveolar process and its mucous membrane may be preserved as much as possible. The injuries to the teeth resulting from Denker's operation, when carried out as described, are too rare to warrant substitution of another method.

EDITOR'S ABSTRACT.

OBSERVATIONS ON MUCK'S EPINEPHRINE PROBE TEST. SOMMER and DAHLEM, Ztschr. f. Hals- Nasen- u. Ohrenh. **30**:273 (Dec. 18) 1931.

Sommer and Dahlem report the results of a series of Muck's epinephrine probe tests conducted on forty-four patients. Each of the patients was examined simultaneously by both of the authors, but their observations were made independently of each other and their notes were kept strictly apart. Their results, which agreed perfectly in forty-one cases, show the reliability of this test when conducted by some one skilled in its use. Detailed reports of the test are given for eight cases, which were selected to show different clinical pictures. In connection with these reports the authors point out the difficulties that may be encountered, which they think cannot be stressed enough. In all cases in which the results of the test are of great importance, several control tests should be made. In patients with crust formation or mucous coats on the lower turbinate, or those in whom a crooked septum prevents thorough examination of the turbinate, the test cannot be performed. The clinician should beware of mistaking a mucous band for the white streak sign. Removal of deposits of mucus may only be done with extreme care, so that the test reaction will not be affected. Weather conditions influence the test; in wet weather a turbinate may react less to the epinephrine than in dry weather, so that in a case in which a white streak sign has been previously observed

there is only a poorly differentiated streak of contraction. Weather accounts also for the wide variation in the number of injections required by a patient at different test periods. The number of injections required depends also on the color of the turbinate. If pale turbinates receive too much epinephrine, the white streak sign is lost to view in the general ischemia. Injections into children should be light and should be made carefully, as the small size of the turbinate increases the difficulty of observation and the disappearance of the epinephrine pallor may simulate a streak sign. This may also occur in adults with small turbinates and shows the importance of watching the exact site of the probe streak. Sufficient time must be allowed for the white streak sign to appear; this sometimes requires four or five minutes. Return of the turbinate to its normal condition is not to be considered as the completion of the reaction, but may be followed by the appearance of the streak sign. In conclusion, the authors emphasize again the importance of a thorough knowledge and much practice for the satisfactory utilization of this test.

EDITOR'S ABSTRACT.

ALEUKEMIC LYMPHADENOSIS WITH INVOLVEMENT OF THE MUCOUS MEMBRANE IN THE REGION OF THE UPPER RESPIRATORY PASSAGE. G. KRIEGSMANN, Ztschr. f. Hals-, Nasen- u. Ohrenh. **30**:281 (Dec. 18) 1931.

Kriegsmann describes a case of aleukemic lymphadenosis in a man of 68. He finds two points of special interest in the case: (1) the remarkable results of the roentgen therapy and (2) the unusual character of one of the tumors. The author considers his case a brilliant example of the rapid regression of swellings in aleukemic lymphadenosis in response to roentgen therapy. All but one of the tumors, which was removed surgically, were exposed to the roentgen rays, and each one disappeared completely shortly after roentgenization. As roentgen treatment in this disease can be considered only as a symptomatic therapy, the author admits the possibility of a recurrence of the tumors, although none had appeared at the time of publication of his report. Another possibility is that his patient was in the aleukemic preliminary stage of a lymphatic leukemia. The tumor described by the author was located in the supra-orbital region near the nose. Contrary to other tumors, this one was rigid and could not be moved from its base, but the skin above it was movable. Incision of the soft tissue revealed a well circumscribed, soft, gray, gelatinous mass lying under the unchanged soft tissue below the periosteum. The tumor extended into the frontal sinus through a cherry-sized opening in the bone. The sinus was completely filled by the tumor. Histologic examination of the tumor following its removal revealed a diffuse lymphoid tissue containing many mitotic figures and a few reticulo-endothelial cells. The involvement of the mucous membrane in lymphatic leukemia has been twice reported by Menzel. The author saw a marked histologic resemblance between his case and one of those described by Menzel in which the mucous membrane of all the accessory nasal cavities was swollen and gelatinous and contained leukemic infiltrations. The destruction of the frontal bone by the growing tumor, as described in this case, is also unknown in the literature of otolaryngology.

EDITOR'S ABSTRACT.

Miscellaneous

CONGENITAL ATRESIA OF THE ESOPHAGUS WITH TRACHEO-ESOPHAGEAL FISTULA. ALEXANDER H. ROSENTHAL, Arch. Path. **12**:756 (Nov.) 1931.

Including the author's 8 cases, 255 cases of congenital esophageal stricture have been reported. In 205 of these a tracheo-esophageal fistula was also present. Clinically these infants are well developed at birth. When an attempt is made to feed them they take a few swallows readily, but then they cease to breathe, become cyanotic and regurgitate a frothy discharge through the nose and mouth. After appearing almost lifeless for a short time, they recover, to go through the

same performance again if another attempt is made to feed them. If a catheter is passed into the esophagus, it meets an obstruction about 10 cm. from the alveolar ridge. The author describes the gross anatomic structure in 8 cases and the microscopic structure in 4 of these. He also discusses the various theories that have been advanced to explain the anomaly, and discards all except one presented by George L. Streeter, namely, that of an early fundamental deficiency in the entodermal cells which give rise to the esophagus. The article is well illustrated.

LESLIE, Evanston, Ill. [AM. J. DIS. CHILD.].

COMPARATIVE STUDIES OF STOMATITIS CAUSED BY DRUGS FROM THE GROUP OF HEAVY METALS. A. HEINDL, Monatschr. f. Ohrenh. **65**:1467 (Dec.) 1931.

Heindl describes and compares several cases of stomatitis resulting from therapy with mercury, bismuth and gold preparations and briefly reviews some of the literature pertaining to this subject. The author thinks that intoxication with one of these metals is not the specific cause of the stomatitis that often follows but is to be considered as a predisposing influence which, together with a possible syphilitic infection, prepares the ground for bacterial infection. Intoxication with a preparation of one of these metals, besides producing a lowering of vitality, disturbs the nutrition of the tissues and decreases the bactericidal action of the saliva, thereby favoring the invasion of the tissues by the bacteria present in the mouth. A harmless inflammatory process of the gums and mucous membrane is thus transformed into a serious necrotic process. If the tissues have been weakened by syphilitic infiltrations, the development of a stomatitis is favored. The presence of decayed teeth and the use of tobacco and fresh fruit are considered contributing factors in the development of stomatitis. The author suggests that therapy with any preparation of the heavy metals be preceded by a thorough examination of the teeth and possible extraction of diseased teeth. During and after therapy, the mouth should be cleansed several times daily with hydrogen dioxide because of its prompt effect in combating the anaerobic bacteria chiefly concerned in this infection. The use of tobacco and eating of fresh fruit is to be avoided during the course of treatment and the close observation of kidney function and the corresponding regulation of diet are advised.

EDITOR'S ABSTRACT.

Society Transactions

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OTOLOGY AND LARYNGOLOGY

R. M. Wolff, M.D., *Reporter*

Feb. 17, 1932

Ralph Butler, M.D., *Chairman*

Sinusitis and the Rôle It Plays in the Production of Asthma. Dr. H. B. Wilmer.

It is well recognized by most observers in the field of allergy that subacute and chronic infections of the upper respiratory tract, such as sinusitis, tonsillitis and adenoiditis, are important etiologic and contributory factors in the causation of asthma; but they are at variance as to the relative importance of such factors and the mechanisms by which they operate.

It is definite, and, I believe, thoroughly possible that, in asthma as well as in hay fever, nasal infection may play the rôle of an excitant as well as a complicating factor.

Quoting Gottlieb, the upper respiratory tract may cause bronchial asthma by one of the following explanations:

1. Constant drainage of pus into the trachea and bronchi.
2. Toxic absorption from damming up pus in the sinuses.
3. Mechanical obstruction of the air passages causing mouth-breathing, thereby irritating the pulmonary mucous membrane.
4. Reflexly by irritation or infection of the sphenopalatine ganglion.

I definitely feel that nasal obstruction with resultant mouth-breathing plays an important rôle in the etiology of asthma. Infected tonsils and adenoids are also etiologic factors in asthma, but are too often blamed and removed without justification. Intranasal operations and tonsillectomy should be resorted to in an asthmatic person only after a careful examination has ruled out atopic hypersensitiveness.

The failures to relieve the symptoms permanently with surgical procedures far outnumber the permanent cures. I do not believe any surgical procedure is wise during the pollination period unless extremely urgent. A potentially allergic person may become clinically active following nasal operation during the hay fever season.

The efficacy of vaccine therapy has been discussed pro and con for many years. I, personally, have had more than moderate success with this form of treatment, as shown by the following results: with bacterins only in a total of 141 cases, no relief in 31; improvement in 73 and cure in 37.

I feel that the success of bacterin therapy lies in the collection of the nasal smear, the care with which it is prepared, the method of testing and the method of administration. Each organism is isolated and cultured, and the patient tested intradermally. The organisms producing immediate and delayed reactions are used in the preparation of the bacterin. Reculturing may be necessary before results are obtained.

When there is decided infection of the nares or sinuses, bacterin therapy alone, without the aid of the otolaryngologist, is futile. Frequently a stock vaccine may be used with as much success as an autogenous preparation. It has been my

procedure to give small doses of the vaccines over a long period of time. They are given at intervals of from five to seven days. Many patients will require continued administration at monthly intervals after the initial dosage has been given, especially through the winter months, as an aid preventing relapses.

The instance of bacteria found in 682 cases of asthma was as follows: staphylococcus, 237; streptococcus, 493; pneumococcus, 350; catarrhalis, 306; diphtheriod, 118, and gram-negative bacillus (Friedlander's), 101. The instance of bacteria found in nasal smears of 122 cases of asthma was: staphylococcus, 82; streptococcus, 45; pneumococcus, 28; catarrhalis, 21; diphtheroid, 36, and gram-negative bacillus (Friedlander's), 12.

BRONCHIAL ASTHMA FROM THE RHINOLOGIC STANDPOINT. DR. HARRY P. SCHENCK.

While bronchial asthma has come to be regarded as an effect resulting from more than a single process, and many of the precipitating factors have been recognized, the actual cause of asthma remains unknown. The mechanism of the asthmatic paroxysm was described, and the various possibilities of vagus stimulation discussed. Intranasal pathologic processes may influence bronchial asthma by reflex stimulation of the vagus or by influencing bacterial sensitization. Experimental work which points to a nervous pathway from the nose to the peripheral bronchial fibers of the vagus was described, while it was emphasized that the actual pathway has never been satisfactorily traced. Bacterial allergy, while not well understood, is operative because of blood-borne protein fractions, polysaccharids or amins which may directly stimulate the vagus endings.

Allergists and rhinologists are agreed that the asthmatic patient is primarily an allergic problem. The rhinologist should enter the picture only after the completion of skin tests and either failure or unsatisfactory results from desensitization and elimination of reactors. The end-results of nasal operation differ in various clinics, and whether to employ radical or conservative measures is still in dispute. Not every asthmatic patient has sinus disease. The development of edema of the soft tissues and polypoid degeneration with later secondary infection of the paranasal chambers does not occur suddenly. If asthma precedes extensive changes in the nasal structures, the allergist is often able by the elimination of reactors and desensitization to prevent alterations in the upper respiratory tract. It is as important to prevent a nasal pathologic process as to prevent emphysema and chronic bronchitis. The future asthmatic person with present vasomotor rhinitis and pollen sensitivity, frequently consults the rhinologist first, and it is his responsibility to detect early allergic alterations and his duty to guide the patient to the allergist. Early prophylactic measures of this sort are more valuable than any amount of radical surgery in the advanced case. Early cases require no surgical measures and are frequently made worse by intranasal medication.

Operation on the allergic person is always attended by certain elements of danger. Allergic symptoms frequently follow surgical procedures. They should never be performed on an allergic person during the active pollen season. Postoperative sensitization to bedding materials may occur. The rhinologist may well blunder into increasing rather than alleviating allergic symptoms. Asthmatic patients are particularly prone to postoperative erysipelas.

The asthmatic patient may be worse after operation because of (1) sensitization to new atopens at the time of operation or shortly thereafter, (2) reflex stimulation of the vagus by tight packing, or postoperative edema of the tissues, (3) denudation areas facilitating the absorption of allergens and (4) infection of new areas due to faulty technic, such as failing to remove packing within a reasonable time.

The asthmatic patient may be worse after operation because: 1. Surgical methods have been employed where there is no indication for them. (This item is the most important.) A submucous resection on a septum which is angular

but fails to make lateral contacts is not likely to be of benefit. 2. Incomplete surgical measures have been used. Polyps are removed from one antrum while they are permitted to remain undisturbed in the other. 3. Faulty postoperative treatment has been employed. Adhesions must not be permitted to form. New tissue is subject to the same allergic influence as the disease tissue removed, and unless one is prepared to protect the new tissue it is useless to remove the old. The rhinologist is concerned primarily in securing aeration and drainage. Local measures such as colloidal silver packs, roentgen or radium therapy and physical agents were discussed. Vitamins and acid-base diets were outlined.

In surgical procedures on these patients no cure should be promised, but remissions may usually be expected during which the patient gains weight and regains some measure of hope. Because of the necessity for multiple procedures, it is imperative to secure good local anesthesia and observe the greatest delicacy in the manipulation of instruments, so that the patient may approach successive operations without fear and with confidence in the operator. The patient must be repeatedly warned that attention to diet and elimination of other reactors are important after operation, and that surgical intervention is only one line of attack. Both allergists and rhinologists are confronted by the unsolved problem of what to do about nasal pathologic processes in asthmatic persons. Neither a *laissez faire* policy nor indiscriminate radical surgical measures has solved the problem, but there is definite evidence that conservatism is a safe rule.

DISCUSSION ON THE PAPERS OF DR. WILMER AND DR. SCHENCK

Dr. John A. Kolmer: I have enjoyed the two papers this evening, and agree with most of the points stated. My mind has been well made up in regard to the sinuses in allergic persons. If skin tests are positive, then proceed without surgical intervention; if the tests are negative, then bacterial antigen is probably the cause and the sinuses should be carefully examined, and if found involved, I advise operation. Relapse occurs in most cases in which surgical measures are employed and the question is asked, why? I believe that it is due to incomplete removal of all infected material, which is almost impossible. In a case of frontal sinusitis improvement followed for two months after intranasal operation then a relapse occurred. A radical operation was done, and the patient has been symptom-free for two years.

I believe that persons acquire a sensitivity to bacterial proteins, and in the majority of cases the sinuses are involved.

Dr. Richard A. Kern: From what has been said it seems that we are agreed that bronchial asthma is a syndrome of symptoms. The question of which mechanism is of prime importance in asthma has been answered contradictorily. The former point of view is wrong due to the particular type of patients studied. Now the clinics study patients of all ages and from every angle.

The most important factor in 75 per cent of cases is hypersensitivity, and in 25 per cent infection and nasal reflex. Frequently the cases are a combination of these two groups.

Just how infection complicates asthma is not clear. Sinus infection in this locality is common, and in 72 per cent of cases, used as controls in an asthmatic study by Schenck and myself, there was found sinus infection. It was also shown by roentgenograms that the asthmatic patients had a smaller percentage of sinus infection. Too much stress should not be placed on the relation of sinuses to asthma.

It is hard to find a rhinologist who is willing to use measures radical enough to clean out all infection, yet it is important to remove completely all pathologic tissue. Even radical operation is sometimes followed by poor results. I saw one case in which a bilateral Caldwell-Luc operation had been done, and a secondary operation showed more pathologic process in the antrums than was there before. I only saw one case in which tonsillectomy helped asthma.

I believe in bacterial protein allergy, but feel that the initial dose should be extremely small.

DR. ARTHUR WAGERS: I have been pleased by the note of conservatism in the papers and discussion tonight. My feeling is that nasal conditions rarely cause asthma. However, a definitely pathologic sinus or irregular septum can initiate the asthmatic spasm.

Roentgenograms of the sinus are frequently reported negative; but there are other methods of determining if a pathologic process is present, and these should always be used in making a diagnosis. If polyps are found, they should be removed. Dr. Kern's remark regarding thorough operation is timely. The ethmoids, due to their anatomic configuration, are difficult of complete exenteration. A careful study of each case is most important.

DR. KARL M. HAUSER: My reaction is one of confusion, and this is due to end-results obtained. Asthma can be caused by reflex without involvement of the sinus or allergy. Adams of Glasgow reported the data in a group of asthmatic persons treated entirely by rearrangement of their diet. Asthma does not occur among the Eskimos. They are not subject to pollens but are constantly in contact with animal emanations. All things have a bearing on asthma, but the real cause has eluded the investigation.

DR. GABRIEL TUCKER: An important point in bronchial asthma that has been overlooked is the wheezing tracheobronchial tree due to spasm of bronchial muscles. After all other methods of treatment fail, patients will frequently respond to bronchoscopic treatment.

DR. GEORGE B. WOOD: Most cultures taken from the nose are contaminated. I have used a glass tube with narrowed lumen at each end connected to a suction tube. The glass tube is placed at the sinus ostium, suction applied and when the tube is withdrawn the ends are sealed. This eliminates contamination, and the tube can be sent directly to the bacteriologist.

DR. SAMUEL R. SKILLERN, JR.: I wonder if the work begun by Stucky and now being carried on by Jarvis, in Vermont, have not hit on the background of asthma in relation to acid-base balance of the body. The red septum is the acid type and can be controlled by an alkaline regimen. The pale septum shows the body balance to be on the alkaline side, and the color can be brought to the septum by administering dilute nitrohydrochloric acid. I believe all foci of infection should be removed in seeking a cure, including the removal of tonsils.

DR. MATHEW ERSNER: Allergy is never found in patients with a red septum. With the pale septum, the secretions from the nose are alkaline in reaction, and in these cases the calcium in the gastro-intestinal tract is not properly assimilated by the body. Starve the patient; then put him on a milk diet; lactic acid is formed and this helps to absorb the calcium. In patients with watery nasal discharge in which eosinophils predominate, allergy should be suspected.

DR. JUSTIN M. WAUGH, Cleveland: The more you see of asthma (as a rhinologist), the less you think of yourself. It is not possible to eliminate all the infections in all the sinuses. Although our present knowledge is in a state of confusion, the succeeding research can go along more smoothly by discarding all worthless reports, just as the study of cancer is being carried on. I do not believe that dietary disasters are the whole cause of asthma, or that it will eliminate asthma. I have not had Dr. Tucker's success with the bronchoscopic treatment.

DR. WILMER: I feel that as allergists we are very much in the dark, but that we are getting results in some of our cases. I agree with Dr. Kerns in radical surgical measures on the sinuses when their involvement is definitely determined. There is no similarity of patients in the field of allergy, and the physician must study each patient as an individual problem.

Book Reviews

Lehrbuch der Mund- und Rachenkrankheiten. Edited by Josef Berberich. Price, 53, marks. Pp. 585, with 213 illustrations. Leipzig: Georg Thieme, 1932.

This is a volume of 585 pages with 213 illustrations, some in colors. There are fourteen collaborators. This is an exhaustive treatise covering the mouth and pharynx and the maxillary antrum. It includes a discussion of the embryology. anatomy and physiology, as well as diseases. It presents the most complete treatise on the diseases of these parts that has appeared, and fills a gap that is covered only in part in the usual textbooks on otolaryngology. The illustrations are new. The volume constitutes a valuable reference book for the general practitioner, as well as the specialist working in otolaryngology.

CORRECTION

In the paper by Dr. J. C. Scal entitled "Nasal Bleeding Treated with Radium: Method of Application," which appeared in the April issue of the ARCHIVES (**15**:617, 1932), the following error occurred:

On page 619, seventh line from the top, "The platinum capsule is 0.1 mm. in thickness" should read, "The platinum capsule is 1 mm. in thickness."

Directory of Otolaryngologic Societies *

FOREIGN

New Zealand British Medical Association, Ear, Nose and Throat Section

Chairman: Dr. James Hardie Neil, Auckland.
Secretary: Dr. W. Gillies Borrie, Auckland.

Royal Society of Medicine, Section of Laryngology

President: Dr. Walter G. Howarth, 21 Devonshire Place, W., London.
Secretary: Dr. A. Lowndes Yates, 33 Weymouth St., W. 1, London.

Royal Society of Medicine, Section of Otology

President: Dr. Norman Patterson, 82 Portland Pl., W. 1, London.
Secretary: Dr. T. B. Jobson, Netherwood, Epsom Road, Guildford.

NATIONAL

American Medical Association, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Gabriel Tucker, Bronchoscopic Clinic, Hospital of the University of Pennsylvania, Philadelphia.
Secretary: Dr. John J. Shea, 1018 Madison Ave., Memphis, Tenn.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. S. Hanford McKee, 1528 Crescent St., Montreal, Canada.
President-Elect: Dr. B. R. Shurley, 62 W. Adams Ave., Detroit.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: Montreal, Canada. Time: Sept. 19-23, 1932.

American Bronchoscopic Society

President: Dr. Louis H. Clerf, 128 S. Tenth St., Philadelphia.
Secretary: Dr. Richmond McKinney, 899 Madison Ave., Memphis, Tenn.
Place: Atlantic City, N. J. Time: May 21, 1932.

American Laryngological Association

President: Dr. George E. Shambaugh, 122 S. Michigan Ave., Chicago.
Secretary: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Place: Atlantic City, N. J. Time: May 19-21, 1932.

American Laryngological, Rhinological and Otological Society

President: Dr. Edmund Prince Fowler, 140 E. Fifty-Fourth St., New York.
Secretary: Dr. R. L. Loughran, 33 E. Sixty-Third St., New York.
Place: Atlantic City, N. J. Time: May 23-25, 1932.

American Otological Society

President: Dr. L. W. Dean, Washington University, St. Louis.
Vice President: George L. Tobey, 270 Commonwealth Ave., Boston.
Secretary: Dr. Thomas J. Harris, 104 E. Fortieth St., New York.
Place: Atlantic City, N. J. Time: May 17-19, 1932.

SECTIONAL

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. F. M. Sulzman, 1831 Fifth Ave., Troy.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

NEW ENGLAND OTOLOGICAL AND LARYNGOLOGICAL SOCIETY

President: Dr. Henry A. Barnes, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. Lyman G. Richards, 319 Longwood Ave., Boston.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. W. F. Hoffman, 317 Summit Ave., Seattle.
Secretary-Treasurer: Dr. J. Frank Friesen, 1208 Roosevelt Bldg., Los Angeles.
Place: Seattle: Time: June 30-July 2, 1932.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. John H. Harter, 1215 Fourth Ave., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, 806 Cobb Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. John B. Gregg, 101 S. Main Ave., Sioux Falls, S. D.
Secretary-Treasurer: Dr. Frederick H. Roost, 420 Trimble Bldg., Sioux City, Iowa.
Place: Sioux City, Iowa. Time: November, 1932.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Wiley R. Buffington, 211 Camp St., New Orleans.
Secretary: Dr. W. D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Place: Birmingham, Ala. Time: November, 1932.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. W. E. McGarvey, 802 Jackson City Bank Bldg., Jackson.
Secretary: Don C. Lyon, 1405 Union and Peoples National Bank Bldg., Jackson.
Time: Third Thursday of alternate months.

STATE

COLORADO OTO-LARYNGOLOGICAL SOCIETY

President: Dr. F. J. Peirce, 511 N. Main St., Pueblo.
Secretary: Dr. Rex L. Murphy, Metropolitan Bldg., Denver.
Place: Assembly Room of Metropolitan Bldg. Time: First Saturday of each month from October to May.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. M. H. Merriman, 115 Prospect St., Waterbury.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. William L. McDougall, 50 Whitehall St., S. W., Atlanta.
Secretary-Treasurer: Dr. William O. Martin, Jr., 412 Medical Arts Bldg., Atlanta.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. J. R. Gillum, 221 S. Sixth St., Terre Haute.
Secretary: Dr. J. Kent Leasure, 611 Hume-Mansur Bldg., Indianapolis.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Royal French, 28 S. First Ave., Marshalltown.
Secretary-Treasurer: Dr. W. F. Boiler, 105 East Iowa Ave., Iowa City.

MICHIGAN STATE MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Wilfred Haughey, 303 Post Bldg., Battle Creek.
Secretary: Dr. H. O. Westervelt, 239 Pipestone St., Benton Harbor.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Douglas Wood, 74 S. Ninth St., Minneapolis.
Secretary-Treasurer: Dr. W. E. Camp, Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month, October to May.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. W. J. Marshall, 212 N. Higgins Ave., Missoula.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.
Time: Semi-annually.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION

Chairman: Dr. R. T. Atkins, 4 W. 53d St., New York.
Secretary: Dr. D. F. Gillette, 109 S. Warren St., Syracuse.
Place: Buffalo. Time: May 23-24, 1932.

NEW JERSEY STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY, OTOLOGY AND RHINOLARYNGOLOGY

Chairman: Dr. H. L. Harley, 101 S. Indiana Ave., Atlantic City.
Secretary: Dr. B. E. Failing, 31 Lincoln Park, Newark.
Place: Atlantic City. Time: June 15-17, 1932.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. F. L. Wicks, Valley City.
Secretary-Treasurer: Dr. W. L. Diven, National Bank Bldg., Bismarck.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. H. M. Hendershott, 193 Eleventh St., Portland.
Secretary: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. Frank W. Dimmitt, 195 Thayer St., Providence.
Secretary: Dr. N. A. Bolotow, 108 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. B. McWhorter, 106 E. Earle St., Anderson.
Secretary-Treasurer: Dr. G. M. Truluck, Orangeburg.
Time: April and December.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. W. D. Jones, 3116 Live Oak St., Dallas.
Secretary: Dr. A. F. Clark, 1034 Nix Bldg., San Antonio.
Place: Fort Worth. Time: December, 1932.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. F. M. McHugh, 17 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. W. Leroy Smith, Erza Thompson Bldg., Salt Lake City.

VIRGINIA SOCIETY OF OTOLARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. C. P. Jones, 3117 West Ave., Newport News.
Secretary-Treasurer: Dr. Henry Grant Preston, Harrisonburg.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. G. A. Smith, Montgomery.
Secretary: Dr. O. H. Bobbitt, Medical Arts Bldg., Charleston.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Charles W. Buvinger, 50 Washington St., East Orange.
Secretary: Dr. Earl LeRoy Wood, 192 Roseville Ave., Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. L. C. Rouglin, 127 Peachtree St., N. E., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., 412 Medical Arts Bldg., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St., N. E. Time: 8 p. m., last Thursday of each month.

Baltimore City Medical Society, Section on Otology and Laryngology

President: Dr. James J. Chisolm, Medical Arts Bldg., Baltimore.
Secretary: Dr. Louis Diener, 2449 Eutaw Pl., Baltimore.
Place: 1211 Cathedral St. Time: 8:30 p. m., last Friday of each month.

Buffalo Oto-Laryngological Society

President: Dr. John F. Healey, 925 Delaware Ave., Buffalo.
Secretary-Treasurer: Dr. Herrmann E. Bozer, 468 Delaware Ave., Buffalo.
Place: Buffalo Club. Time: Second Tuesday of each month from September to May, inclusive.

Chicago Laryngological and Otological Society

President: Dr. Howard C. Ballenger, 25 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Austin A. Hayden, 25 E. Washington St., Chicago.
Place: Medical and Dental Arts Bldg., 185 N. Wabash Ave. Time: 6 p. m., first Monday of each month from October to May.

Cincinnati Oto-Laryngological Society

President: Dr. M. F. McCarthy, Union Central Bldg., Cincinnati.
President-Elect: Dr. Henry M. Goodyear, 19 Garfield Pl., Cincinnati.
Secretary-Treasurer: Dr. Samuel Seltz, Provident Bank Bldg., Cincinnati.
Place: University Club. Time: 6:45 p. m., second Tuesday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. M. W. Jacoby, 2323 Prospect Ave., Cleveland.
Secretary: Dr. H. C. Rosenberger, 1065 Rose Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.
President: Dr. Edward D. King, 707 Race St., Cincinnati.

College of Physicians of Philadelphia, Section on Otolaryngology

Chairman: Dr. Ralph Butler, 2007 Chestnut St., Philadelphia.
Clerk: Dr. Karl M. Houser, 1826 Pine St., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., third Wednesday of each month from October to June.

Columbus Ophthalmological and Otolaryngological Society

Chairman: Dr. Ivor G. Clark, 188 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. Francis W. Thomas, 327 E. State St., Columbus, Ohio.
Time: First Monday of each month.

Dallas Academy of Ophthalmology and Otolaryngology

President: Dr. L. M. Sellers, 1717 Pacific Ave., Dallas, Texas.
Secretary: Dr. W. Mood Knowles, 1717 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DES MOINES ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. C. F. Howland, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: Third Monday of each month, September to May, inclusive.

DETROIT OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Raymond Goux, 1551 Woodward Ave., Detroit.
Secretary-Treasurer: Dr. R. Lee Laird, 513 David Whitney Bldg., Detroit.
Place: Maccabees Bldg. Time: Third Wednesday evening of each month from October to May.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. R. H. Needham, 1304 Medical Arts Bldg., Fort Worth, Texas.
Secretary: Dr. Van D. Rathgeber, 1011 Medical Arts Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

GRAND RAPIDS EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Carl F. Snapp, Medical Arts Bldg., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Walter W. Oliver, 26 Sheldon Ave., Grand Rapids, Mich.
Place: Various local hospitals. Time: 6:30 p. m., third Thursday of alternating months, September to May.

HOUSTON ACADEMY OF MEDICINE, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. L. W. Raney, 609 Fannin St., Houston, Texas.
Secretary: Dr. J. F. Gamble, 201 Main St., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. B. J. Larkin, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: Indianapolis Athletic Club. Time: 6:30 p. m., second Thursday of each month from October to May.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. E. Keith, 1103 Grand Ave., Kansas City, Mo.
Secretary: Dr. O. S. Gilliland, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. R. R. Montgomery, 102 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Russell T. Uhls, 823 Security Bldg., Long Beach, Calif.
Place: Pacific Coast Club. Time: Last Wednesday of each month from September to June.

LOS ANGELES COUNTY MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. J. Frank Friesen, 1208 Roosevelt Bldg., Los Angeles.
Secretary-Treasurer: Dr. F. H. Brandt, 1052 W. Sixth St., Los Angeles.
Place: Mary Louise Cafe. Time: 6:30 p. m., fourth Monday of each month, May to November, inclusive.

MEDICAL SOCIETY OF THE COUNTY OF KINGS, SECTION ON OTOLARYNGOLOGY

Chairman: Dr. Edward Leo Berger, 903 Park Pl., Brooklyn.
Secretary-Treasurer: Dr. Oscar Rodin, 893 Eastern Parkway, Brooklyn.
Place: Library Bldg., County Society, 1313 Bedford St., Brooklyn.
Time: 9 p. m., second Wednesday of January, March, May and November.

Medical Society of the District of Columbia, Section on Ophthalmology and Oto-Laryngology

Chairman: Dr. James A. Flynn, 1511 Rhode Island Ave., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month.

Memphis Society of Ophthalmology and Oto-Laryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

The Milwaukee Oto-Ophthalmic Society

President: Dr. T. F. McCormick, 324 E. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 324 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Hilliard Wood, 700 Church St., Nashville.
Secretary-Treasurer: Dr. H. C. Smith, Medical Bldg., Nashville.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month, October to June.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. Charles A. Bahn, 150 Baronne St., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: January to June and October to January—third Thursday of each month.

New York Academy of Medicine, Section of Laryngology and Rhinology

Chairman: Dr. Charles Imperatori, 17 E. 38th St., New York.
Secretary: Dr. Marvin F. Jones, 121 E. 60th St., New York.
Place: 103d St., and 5th Ave. Time: 8:30 p. m., fourth Wednesday of each month from October to May.

New York Academy of Medicine, Section of Otology

Chairman: Dr. Clarence H. Smith, 2 E. 54th St., New York.
Secretary: Dr. James Garfield Dwyer, 57 W. 57th St., New York.
Place: 103d St. and 5th Ave. Time: Second Friday of each month from October to May.

Omaha and Council Bluffs Ophthalmological and Otolaryngological Society

President: Dr. W. P. Haney, 107 S. 17th St., Omaha.
Vice President: Dr. L. G. Howard, 532, 1st Ave., Council Bluffs, Iowa.
Secretary-Treasurer: Dr. W. A. Cassidy, 1620 Medical Arts Bldg., Omaha.
Place: University Club, 1914 Harney St., Omaha. Time: Dinner, 6 p. m. Program, 7 p. m., third Wednesday of each month from October to May.

Philadelphia Laryngological Society

President: Dr. Arthur J. Wagers, 1429 Spruce St., Philadelphia.
Secretary: Dr. Herman B. Cohen, 1301 Spruce St., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., first Tuesday of each month from October to June.

Pittsburgh Otological Society

Chairman: Dr. Roy C. Cooper, 510 S. Aiken Ave., Pittsburgh.
Secretary-Treasurer: Dr. Alexander R. Hampsey, 806 May Bldg., Pittsburgh.

Richmond Ophthalmological and Oto-laryngological Society

President: Dr. William R. Weisiger, Medical Arts Bldg., Richmond, Va.
Secretary: Dr. R. W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. E. S. Amsler, 53 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. E. W. O'Brien, 5 N. Goodman St., Rochester, N. Y.
Place: Rochester Medical Association, 13 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ear, Nose and Throat Club

Acting President: Senior member of the executive committee: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
Secretary: Dr. B. J. McMahon, 813 Missouri Bldg., St. Louis.
Place: University Club Bldg. Time: Third Wednesday in February, April, October and December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. Scott Applewhite, 706 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. E. D. Dumas, 425 Medical Arts Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Robert Carson Martin, 384 Post St., San Francisco.
Secretary: Dr. George N. Hosford, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco. Time: Third Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. J. L. Scales, Medical Arts Bldg., Shreveport, La.
Secretary-Treasurer: Dr. W. L. Atkins, 505 Medical Arts Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 7:30 p. m., first Monday of each month from October to June.

Spokane Academy of Ophthalmology and Otolaryngology

President: Dr. David Hartin, Old National Bank Bldg., Spokane, Wash.
Secretary: Dr. W. W. Henderson, Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. M. G. Brown, 713 Genesee St., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

Tulsa Academy of Ophthalmology and Otolaryngology

President: Dr. Roy W. Dunlap, 108 W. 6th St., Tulsa, Okla.
Secretary-Treasurer: Dr. Marvin D. Henley, 108 W. 6th St., Tulsa, Okla.
Place: Medical Arts Bldg. Time: Monthly.

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